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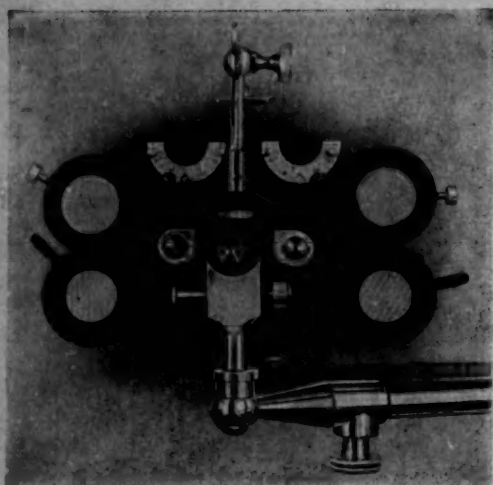
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OPERATION TO SHORTEN A RECTUS MUSCLE WITH BURIED SUTURES

WALTER B. LANCASTER, M.D., F.A.C.S.

BOSTON

The operation now described differs from that recommended by the author in 1918, in that it omits the advancement stitch in the sclera near the cornea; the mattress "security stitch" through the tendon stump and muscle having been found sufficient. It was also found that the sutures did not need to be removed if they were buried.

This operation may be regarded not so much as an addition to the many forms of muscle shortening, but rather as a simplification of some of the approved methods. Certainty, accuracy and ease of performance are the advantages claimed, just what every surgeon claims for his favorite method!

The muscle is exposed by a longitudinal incision from limbus to canthus (figure 1), the conjunctiva is undermined and then dissected off the muscle as far as necessary (figure 2), and the capsule of Tenon is picked up at the margin of the muscle and incised (figure 3); this permits an easy introduction of the strabismus hook (figures 4, 5 and 6). The muscle is isolated by cutting the capsule along each side of the muscle as far backward as necessary (figure 7). With two strabismus hooks the muscle is fully freed from surrounding tissues on both sides and underneath (figure 8).

Prince's forceps are applied in such a position as to mark exactly the amount of shortening intended. One may measure off the distance, determined in advance, by a millimeter scale, by compasses, by the eye or in any other manner. The forceps are clamped to the muscle just in front of the point one wishes to attach to the original insertion.

The tendon is cut off, but a one or two millimeter stump is left. If one prefers to fold, reef or tuck the muscle the tendon is not cut, in that case the sutures are introduced according to the

second or third method. There are several ways of introducing the sutures. I give them in what I regard as the order of preference.

First method. A double-armed white silk suture, not too coarse, is introduced through the stump of the tendon close to the sclera from behind forward, and is brought out just in front of the actual insertion (figure 9A). The two needles are introduced in the same way, one near the center of the tendon and the other near the edge of the tendon; this makes the first stage of a mattress suture. A second double-armed suture is placed in exactly the same way in the other half of the tendon.

These two mattress sutures are now completed by passing the needles from the scleral side through the muscle just back of the Prince's forceps (figure 10, 1). The conjunctiva is not included. One needle should be near the edge of the muscle, and the other about one-third of the width away from the first. At least one-third of the muscle is not included in the suture, and so the muscle is not cut off as by a ligature which includes the whole muscle.

Each mattress suture includes about one-third of the width of the muscle, which is sufficient for a safe hold (figure 9, B and C). In slender muscles one can use judgment; for instance take as much as three quarters in the two sutures and leave only one quarter. The two mattress sutures are slightly farther apart in the tendon stump than they are in the muscle; this tends to

keep the muscle well spread out and not puckered. The width of a muscle is normally greater at its insertion than it is at a point five or ten millimeters back in the muscle.

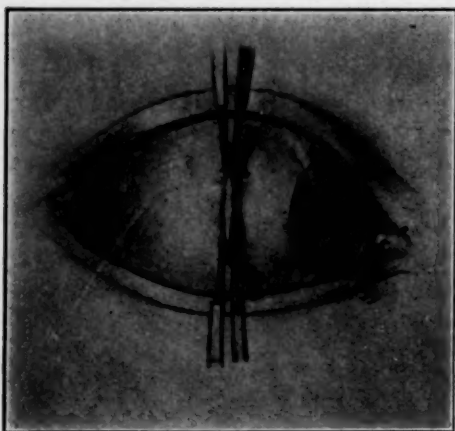


Fig. 1 (Lancaster). Fold of conjunctiva raised by forceps to make conjunctival incision.

The assistant grasps the eyeball at the opposite side of the cornea with fixation forceps near the cornea or in the insertion of the muscle with one



Fig. 2 (Lancaster). Conjunctiva retracted and undermined.

hand and holds the Prince's forceps with the other. The eyeball is rotated toward the muscle to be shortened, and that muscle is gently pulled forward until the portion of each mattress su-

ture in the muscle is directly over its corresponding portion in the stump of the tendon.

The surgeon ties each suture; he is careful to draw the first half-knot

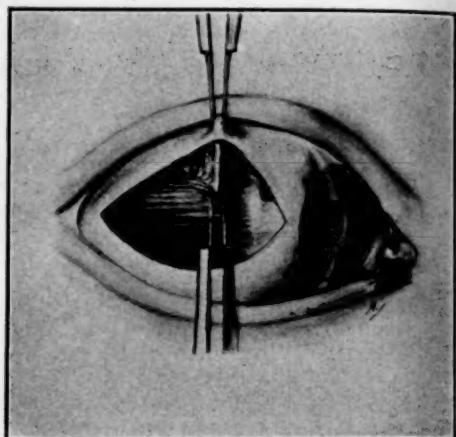


Fig. 3 (Lancaster). Conjunctiva still held by assistant. Capsule of Tenon raised by surgeon's forceps to incise.

tightly enough to take up all slack thread and fasten the muscle firmly to the tendon stump before he ties the second half of the knot. It is usually

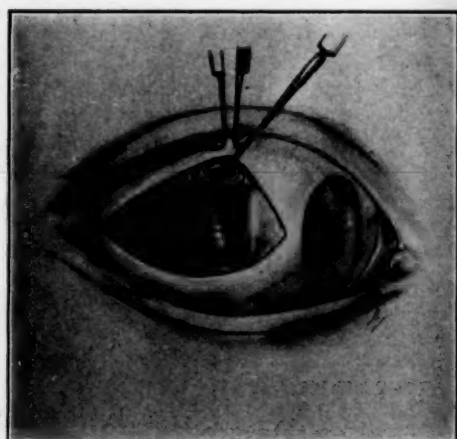


Fig. 4 (Lancaster). Surgeon's forceps laid aside. Hook introduced beneath the tendon, raising capsule at lower margin.

better not to use a surgeon's knot for the first half-knot because it is difficult to draw it tightly enough. Since the assistant is holding the muscle steadily in position there is no strain on the

thread to make it slip, after it has been pulled tight, while the surgeon is tying the other half of the knot (figure 9, D and E). Prince's forceps are removed. The threads are then cut off short,

suture which is not tied. The mattress sutures are buried; they do not have to be removed (figure 9, G).

The antagonist is tenotomized, if necessary, either at this time or after

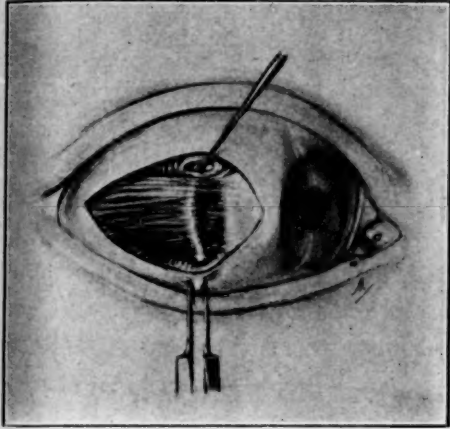


Fig. 5 (Lancaster). Capsule slit at lower margin of tendon, permitting hook to come through.

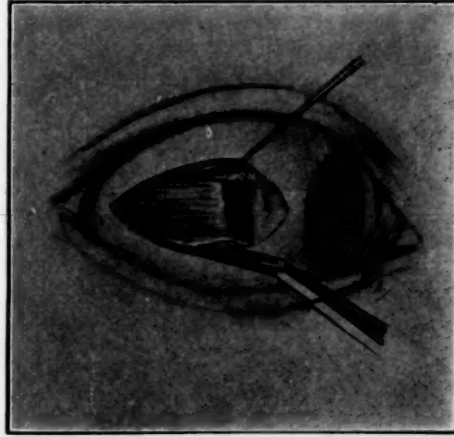


Fig. 7 (Lancaster). Method of isolating tendon by incision with scissors along each edge.

the field is irrigated and sponged and the work is inspected. If there has been only a small shortening the end of the muscle may be left intact. If

a few days when it will have become possible to estimate more accurately whether the shortening was sufficient. If one plans a rather large shortening

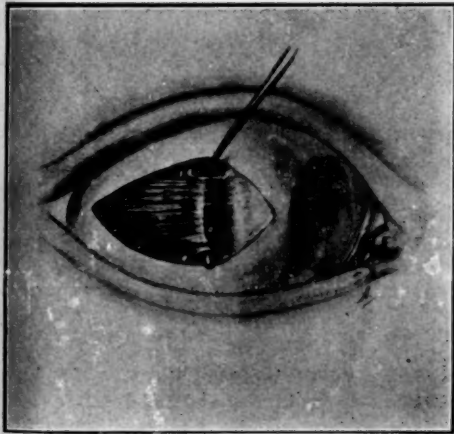


Fig. 6 (Lancaster). Hook fully introduced, point emerging through lower opening in capsule.

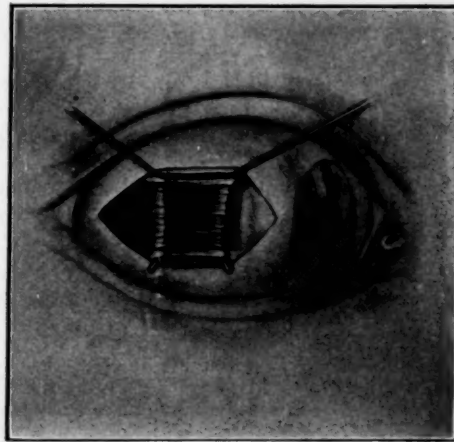


Fig. 8 (Lancaster). Both hooks used to raise tendon ready to introduce the Prince's forceps.

there is too much redundant tissue some of it should be cut off (figure 9, F). The conjunctiva is drawn together and sutured with a running continuous

and intends to do a tenotomy anyway, perhaps with a regulating stitch, the best time to do it is after the first muscle has been exposed and isolated, but

before the stitches have been applied. This makes it easier to tie the sutures. The assistant can grasp the stump of the tenotomized muscle with fixation forceps, to roll the eye into position, more easily after a tenotomy has been

through the tendon stump from behind forward. If a fairly long quarter curved needle is used, it can be passed through both at a single introduction. It is better to pass the needle next to the middle of the muscle first, and the

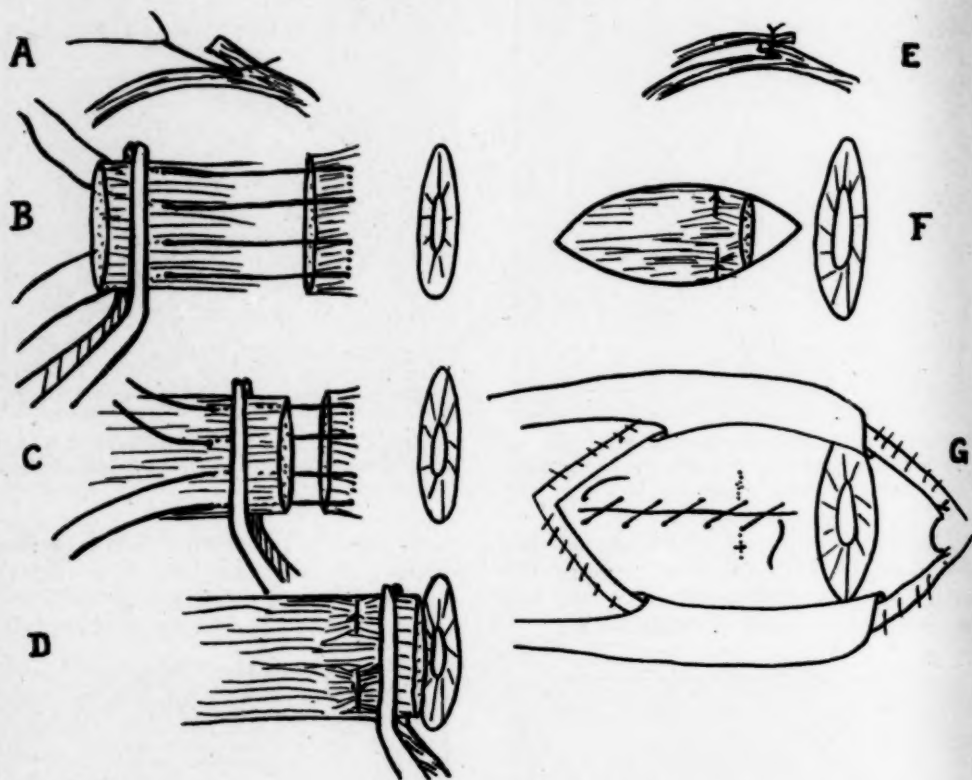


Fig. 9 (Lancaster).

- A. Cross section through tendon insertion and sclera. Needles are introduced through the stump of the tendon close to the sclera.
- B. Muscle held up by Prince's forceps, showing how sutures are to be placed.
- C. Muscle held in normal position, showing position of sutures.
- D. Muscle pulled forward while eye is rotated toward it to facilitate tying the sutures.
- E. Cross section showing how muscle is lapped over tendon stump and securely tied down to it.
- F. Prince's forceps removed and redundant muscle cut off, conjunctiva ready to be sutured over the site of the operation.
- G. Conjunctiva closed by a running continuous suture which need not be tied. Dotted lines show site of buried sutures. If a tuck is made the fold also is buried.

done, because he can secure a better hold and has less resistance to overcome.

A second way to apply the two mattress sutures is to start the needles first through the muscle just back of the Prince's forceps from the conjunctival surface to the scleral surface, and then

needle next to the border second. The other suture is passed in the same way (figure 10, 2).

The first method described laps the muscle over the tendon and ties it down with mattress suture (figure 10, 1). The second method does not lap the muscle over the stump, but raises a

fold, or tuck, or reef, which may or may not be cut, and sutures the under surface of the muscle to the under surface of the tendon (figure 10, 2).

This is less advantageous as it does not produce as firm, secure and smooth an adhesion of muscle to stump. It is a good way to make a tuck or fold when only a small effect is desired. It is also the method to use when a very

muscle behind the Prince's forceps from the scleral to the conjunctival surface; the knots are tied back of the Prince's forceps (figure 10, 3). This is a satisfactory way of making a tuck; it is not a good way for making a resection because it does not lap the ends to be fastened together. This is the method of Fromaget.

I have not included the Reese meth-

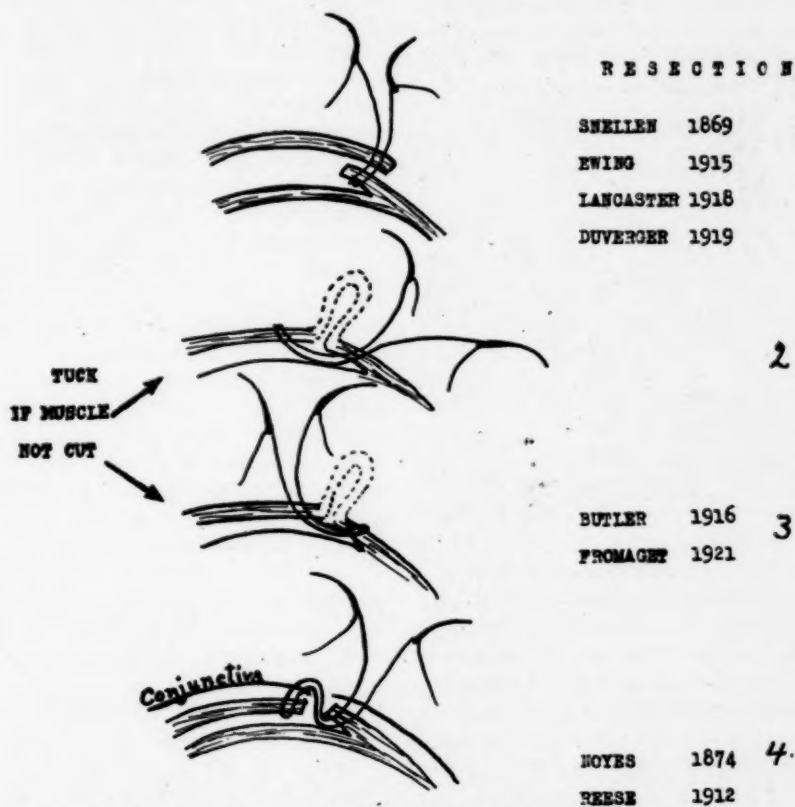


Fig. 10 (Lancaster). Four different ways of inserting the mattress suture through the tendon stump and the muscle in making a resection. Two of them become tucks when the muscle is not cut.

large tuck is wanted, one that is larger than can be secured with a tendon tucker. Personally, I like it better than a tucker for any size of tuck; one can measure the amount more accurately and it is almost as easy to insert the stitches as with a tucker.

The third method of placing the mattress sutures is to introduce the needles from before backward through the tendon stump and then out through the

od of passing the sutures among those that I approve, because it folds the end of the resected muscle under the stump in a way that seems less advantageous than the ones I have described, and because it involves removing the Prince's forceps before tying the sutures; consequently the muscle must be pulled forward to its insertion by the suture only, a single mattress loop through its middle. This will not slip after it is

securely tied, but it is not so safe against slipping during the critical moments of the tying as when held by a well clamped forceps.

The best method of securing anesthesia is also a slight modification of the usual practice. Cocaine four percent instilled four or five times and adrenalin once or twice will give ample anesthesia for incising and undermining the conjunctiva and exposing the muscle and tendon. If one is ready to begin and cocaine has been instilled twice only, time can be saved by applying a tiny wad of cotton, soaked in ten percent cocaine, just over the muscle and tendon and then closing the lids carefully over it for three minutes.

After the muscle has been exposed and before it has been taken up on the hook, novocaine two percent and adrenalin 1 to 10,000 are injected along the muscle back of the tarso-orbital fascia.

If this is done at the beginning of the operation some of the solution may unintentionally be placed in front of the fascia and so infiltrate the field of operation; this makes it slightly more difficult to isolate the muscle. Some surgeons have abandoned the deep injections altogether on this account. By giving the deep injection after the muscle has been exposed the objection is met and the patient is spared the very disagreeable sensations caused by pull-

ing on the muscle with the hooks or Prince's forceps.

It will be seen that this operation differs from the one I described in 1918, in omitting the advancement stitch in the sclera near the cornea. This was abandoned as unnecessary several years ago; the so-called security stitch, a mattress stitch through the tendon stump and muscle were sufficient.

This still left me with the annoyance of having to remove the stitches which were tied outside the conjunctiva. Finally I realized that it was not necessary to remove the sutures if they were buried, and so the operation here described evolved. It has the advantage not only of eliminating the stitch removal but of making the other steps in the operation easier and more exact.

I believe that it is easier to remove these buried stitches than the old type tied outside the conjunctiva. One can secure good anesthesia and ischemia, incise and undermine the conjunctiva, and pick up and cut the sutures with less trouble than he can pick up a suture imbedded in swollen conjunctiva and cut it in the right place. Often enough I have cut off the knot and left a piece of silk buried under the muscle. I have never seen it do harm. This, and the burying of sutures in the tucking operation, convinced me that the operation here described was practical and safe.

520 Commonwealth building.

SOME CONSIDERATIONS OF MUSCLE SURGERY, WITH SPECIAL REFERENCE TO THE TUCKING METHOD

FRANK E. BURCH, M.D., F.A.C.S., AND

HENDRIE W. GRANT, M.D.

SAINT PAUL

The tucking operation is commended for its safety and the ease of performance. It is a valuable procedure for the surgeon who does not operate frequently. The original insertion is preserved and unfortunate complications are avoided. The correction is more permanent than by any other method. Details are given as to the actual amount of correction obtainable by this method as applied to different muscles and to different abnormalities. Read before the American Academy of Ophthalmology, October 27 to 31, 1931.

The accurate measurement and correction of refractive errors, educative treatment to overcome amblyopia in very young children, and orthoptic exercises for selected cases will result in full correction of functional strabismus and heterophoria in approximately fifty percent of patients. The good results of stereoscopic fusion exercises in lateral heterophoria of lower degrees obviate surgery in very many patients. The excellent work now done by ophthalmologists in these directions is resulting in less need for surgical procedure and in more deliberate surgery.

The many individual technical variations of advancement, resection, tucking, and recession operations offer sufficient testimony to the fact that the entire field of muscle surgery still remains a proving ground of methods. Not every ophthalmic surgeon has sufficient material to acquire experience with many methods. Finding a procedure which is satisfactory or approximately so, he adheres to the operation which gives him the best results. A certain degree of eclecticism is necessary, and it is not possible to adhere to a fixed procedure in all cases. The ideal of precision would only be attained if one could apply exact measurement in each of the various procedures undertaken in muscle surgery.

Since not all muscles are alike in length, breadth, thickness, and insertion, and not all nerve centers function similarly, this ideal cannot be attained. The association of millimeters of correction with degrees of deviation will probably always remain a more or less

relative affair. This is particularly true in the correction of strabismus in young children, in whom it is impossible to obtain exact data regarding the relation of adduction to abduction or of convergence to accommodation.

Each individual patient must be regarded as a separate problem. One should take into consideration the effect of wearing the most careful and complete correction of the refractive error over a sufficient period of time, the "functional" correction of the existing muscular deviation thereby obtained, the duration of the deviation, the ocular excursions, any existing contractures, and particularly, as Duane has emphasized, the possibility of a basic vertical paresis. By these observations, together with cumulative experience, one finds that a relative amount of muscle shortening or recession, or both, will produce certain degrees of end result in similar types of case. Time and physiologic adjustment aid results enormously.

Standardization of muscle surgery will only permit of the application of certain fixed principles under very similar conditions. Only mass experiences based upon collective data from many reliable sources will result in a consensus of opinion in evaluating certain generally approved methods of technique. Wide latitude of judgment will always prevail in dealing with the various factors involved in the surgical correction of heterophoria and strabismus.

The objectives to be attained, whether relief of asthenopic symptoms clearly due to muscular imbalance, functional

restoration of binocular vision, or purely cosmetic correction of an unsightly deviation, are the chief considerations which enter into the surgical problem. Analysis of the first of these—that is, muscular asthenopia—requires fine discrimination with careful study of systemic conditions, general health, toxemia, nasal obstruction, vocation and personal habits of the individual, and so on.

In young individuals with heterophoria one may occasionally restore binocular single vision which was previously present only for distant or near vision, but not for both. This may be accomplished if corresponding images result, and if orthoptic exercises are employed to maintain fusion. In older patients with heterophoria, operation should be resorted to only if binocular single vision of a high degree is proved and then only for the relief of symptoms. Binocular single vision is of much less importance than ability to use the eyes comfortably.

Undoubtedly orthoptic exercises should be preceded by surgery more promptly in most convergence insufficiencies than is generally done. We have found that tucking procedures, sometimes supplemented by partial tenotomy, are the safest and most accurate surgical aid we can offer heterophoric patients. On the other hand, too hasty operative correction of muscular imbalance and actual deviation occasionally leads one into the pitfalls of muscle surgery, namely increased asthenopia and diplopia.

Patients with alternating strabismus present the least problem in muscle therapy. Their correction is essentially surgical. If approximate parallelism is safely obtained the patient is happy and his "entourage" is satisfied, unless the strabismus later becomes monocular. A few patients will develop binocular fixation even though the fusion remains defective. Tucking is particularly valuable for alternating strabismus in young children.

Correction of a monocular cosmetic defect, usually associated with amblyopia, is the commonest reason for

surgical intervention. For these patients, the straightening of the deformity relieves selfconsciousness and other psychic states, which is often their reason for desiring operation. In children, whom nature aids in the matter of physiologic adjustment, and in whom the result is sometimes functional as well as cosmetic, early results may be more safely achieved by tucking than by other methods we have employed.

The authors realize the difficulties of presenting new ideas upon muscle surgery. Because of the increasing popularity of tucking operations we desire to record general experiences with our methods during the past nine years. It seems relevant, moreover, to attempt an evaluation of this procedure. Measurements of deviations, their relations to underlying refractive errors, records of the nature and extent of particular surgical corrections employed, and the end results, when obtainable, have been collected and analyzed. Because of changes in method and technique by reason of the fact that measurements have been made by ourselves and associates in various ways, and on account of inability to follow up patients from a distance, it has been well nigh impossible to make a precise analysis. However, it is believed that personal observations and deductions are of definite value.

Since 1920, the tucking procedure has been employed for 144 private patients among 197 muscle-shortening operations. No advancements have been done, resection after the method of Reese being the only other shortening operation used. Our chief reason for favoring the tucking method is its simplicity and safety.

Historical

Muscle tucking is by no means a new procedure. Jackson credits de Wecker with first performing the folding or tucking operation. His purpose was to prevent change in the "plane of action" of the operated muscle. Knapp, in 1886, also proposed a method of folding, which he described as "the same as Critchett's (advancement) without ex-

cision of a piece of tendon". Lagleyze, in 1891, gave prominence to the method of tucking, and he may be properly regarded as the originator of this operation, modifications of which were developed by Savage, Colburn, Magnani, Suffa, Woodruff, Valk, Reber, Bannister, and others. Maxwell, Clark, Green, George, Todd, Bishop, and many others devised instruments to facilitate es-

years two single sutures were tied outside the conjunctiva. Following the suggestion of Dr. Allen Greenwood, the blades now have a width of 9 mm. and are doubly notched. Three buried sutures are now used instead of the two previously tied outside the conjunctiva. Since silk has been used, the tucks are never prominent longer than three weeks, and the irritation and granulo-

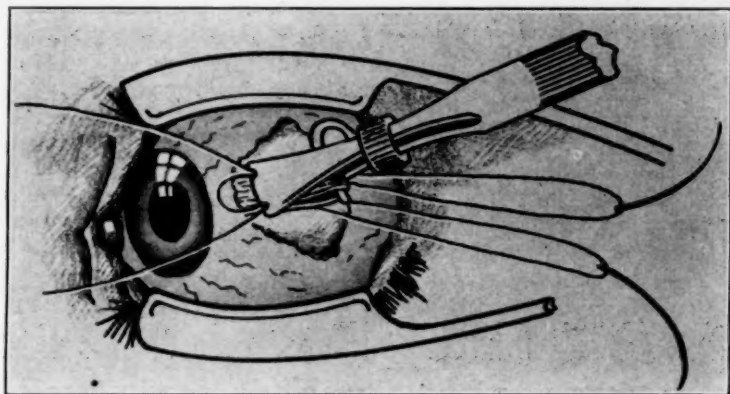


Fig. 1 (Burch and Grant). Method of suturing with instrumental tucking.

timation or measurement of the muscle shortening and to simplify placement of sutures with greater exactness and ease.

In 1921 one of the present writers designed a special instrument for clamping the fold of the muscle at its base and permitting introduction of sutures beneath the blades through the tendon stump. None of the previous instruments was designed for suturing in this manner. Although greater shortening may be obtained without the use of the tendon tucker, the use of this instrument permits the tuck to be held in perfect position, with exact placement of sutures in the muscle so that they may be tied without puckering. An instrument facilitates the tucking operation except when a very high correction is desired.

Tucking technique: The tucking operation now practiced by us differs from that described by one of us in two previous publications (*Archives of Ophthalmology*, July, 1922, and July, 1925). The modified tucker was then notched at its center, and for several

matous humps experienced with catgut are absent.

The great majority of our operations have been in children under general anesthesia. A snug bathing cap is worn to keep hair out of the field. A towel strapped across nose and cheeks with sterile adhesive plaster prevents contamination from the anesthetic, which is administered with a mouth tube by means of the McKesson gas apparatus. Adults are given a hypodermic of morphin and scopolamin one-half hour before going to the operating room. Four percent cocaine is used as a local anesthetic, 10 percent if there is unusual pain. Subconjunctival injections are no longer used, as infiltration complicates the operation and is unnecessary. Infection has been entirely absent since employing thorough skin disinfection with acetone mercurochrome,* rubber gloves, two percent aqueous mercurochrome in the conjunctival sac before, and bichloride ointment after the op-

* Composition of acetone-mercurochrome solution: mercurochrome 40 gm., alcohol, 1100 gm., water 700 gm., acetone 200 gm.

eration. All children wear a Fuchs mask to prevent contamination from fingers during convalescence.

When a lateral rectus is to be shortened the conjunctival incision is made vertically, about midway between the tendon insertion and the canthus. When the inferior rectus is to be tucked, it is easier to pass sutures properly if the conjunctival incision is made

twenty-four inches long. From the tendon side the needles are passed through the notches beneath the tucker. (Figure 1.) The operator holds the tucker and grasps the needle as it emerges beneath it, while the assistant carefully keeps the capsular and conjunctival tissues from being drawn into the notch with the suture. The two needles are cut off, thus making three sutures. The border

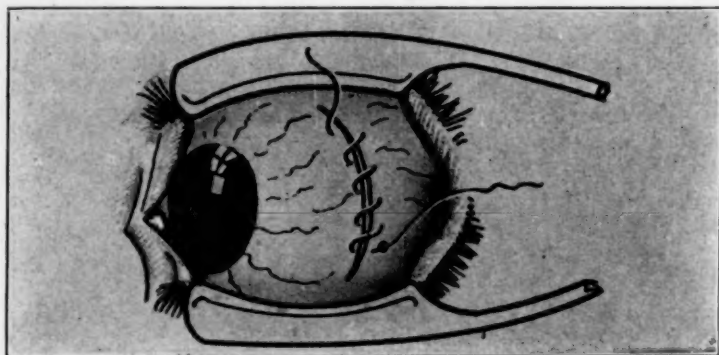


Fig. 2 (Burch and Grant). The untied conjunctival suture.

directly over the tendon insertion. The conjunctiva is freed with the least possible disturbance of subconjunctival tissue. The tendon and muscle are prepared exactly as for Reese's resection, being exposed to their full extent with a minimum disturbance of the capsule.

The tucker hook, extended slightly beyond the open blades, is inserted beneath the tendon and drawn up, by means of a milled nut, approximately 1 mm. for each 2.5 degrees of correction one desires to obtain. The tendon and muscle should be evenly adjusted so that the center of the tendon is over the center of the hook. Care is taken that the instrument is held vertical to the eyeball and muscle and not twisted sideways. When the desired amount of shortening has been obtained, the blades are pressed together and the ring clamp is pushed downward gently, firmly, and as far as possible. It is important to be certain that the blades are snugly clamped before suturing.

Two quarter-curved, twelve millimeter needles are threaded on one number-eight twisted white-silk suture,

sutures are tied first. In using twisted silk one should tie each suture three times to prevent loosening before firm adhesion of the tuck occurs. The central suture is tied firmly with a surgeon's knot, reinforced with two single knots. If the central suture impairs the circulation it probably hastens atrophy of the tucked portion of the muscle. We have always tied the muscle across its entire breadth and have never observed any harm from this. All sutures are cut off close to the knots, remain buried and invisible, and are absorbed.

Tension is now released by reversing the milled nut. The ring clamp is elevated and the tendon hook withdrawn. The fold of tendon and muscle is pushed backward evenly along the muscle but not sutured down, as this seems unnecessary.

The conjunctiva is closed by a running suture of number one twisted black silk with a knot 2 cm. from its lower end, which is left exposed through the canthus. The last turn of the conjunctival suture is not tied after being drawn taut. (Figure 2.) The su-

ture exposed through the canthus may be removed by gentle traction on the fifth day. A child is usually unaware of the removal of this one external suture as it slips through the conjunctiva. No instruments are used, and the child has no fear or knowledge of "removing the stitches". Atropin bichloride ointment is used in the conjunctival sacs, and an eye pad is applied with two-inch elastic

easy. Judgment required in the correction of strabismus has rarely, according to our observation, been based entirely upon actual measurement in millimeters. The old rule of one millimeter of shortening for each five degrees of deviation is by no means a reliable one to follow when resecting or tucking.

Comparing our experiences with those more recently published by Wil-

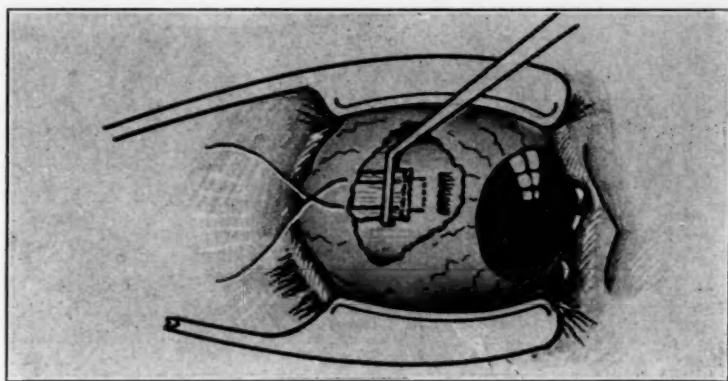


Fig. 3 (Burch and Grant). The Curdy-Wilkinson recession.

adhesive plaster. This is not disturbed except for inspection and renewal of the dressing each day. Frequently both eyes are occluded.

Tenotomy of the central fibers of the opposing muscle and Curdy's recession suture (figure 3) as modified by Wilkinson have been found valuable supplementary procedures. As a matter of fact, treatment of the opponent is always advisable when the deviation is marked and only one eye is operated upon. Very often one may prefer to postpone operation on an opposing muscle if uncertain of the effect of the shortening obtained, but in certain high deviations it should be done first. Patients are informed in advance that one will probably accomplish a satisfactory result by one operation but that it may be necessary to do a second one later. This precautionary advice we have found very useful.

The question most frequently asked by observers of muscle tucking operations is, "How does one estimate the amount of tuck to be taken?" The answer to this difficult question is not

liamson-Noble, Peters, Wilkinson, and others, we have reviewed the results after resection or tucking operations have been performed. We have found that without tenotomy of the opposing muscle the average correction in Reese operations has been approximately three degrees per millimeter of shortening. On the other hand, our figures in a series of tucking operations have been quite a remarkable revelation. We have found an average of two and one-half degrees per millimeter of shortening by tucking operations to be more nearly correct when the opposing muscle is not operated upon.

One finds on exposure various types of tendinous insertion, the capsule of Tenon and the muscle thickened or attenuated, with a tenseness or laxity of both. These anomalies can rarely be predetermined, but must influence judgment during operation as to the amount of tuck to be taken.

The amount of correction which may be obtained by reasonable and safe instrumental tucking of a rectus muscle, without tenotomy of an opponent, va-

ries also with the particular muscle involved. For example, in tucking an inferior rectus for hyperphoria the shortening is relatively less than that required for an esophoria or an exophoria. One may expect here approximately three degrees for each millimeter of folded muscle. In a case of exophoria of twelve degrees with adduction only slightly less than abduction

amount of tucking which an external rectus muscle will safely stand and still permit easy insertion of the needles under the notches of the tucker. The same amount of correction per millimeter is obtainable in the case of the internal rectus, but this muscle will permit of only about five millimeters of easy instrumental tucking and passing of sutures. The following table of approxi-

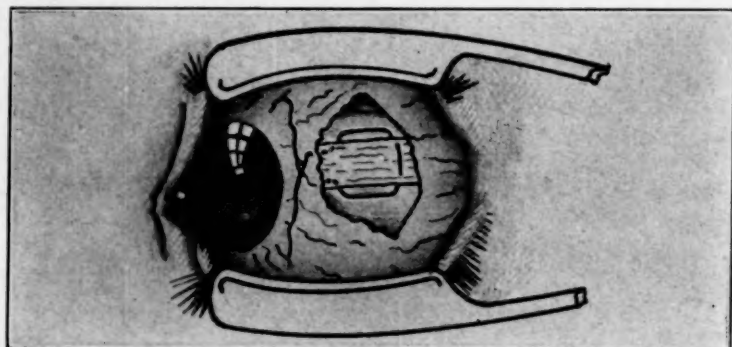


Fig. 4 (Burch and Grant). Modified Lagleyze muscle fold without instrument.

(for example, adduction ten degrees), one may expect only about two degrees of correction for each millimeter of folded muscle. Likewise, an esophoria of twelve degrees with high adducting and low abducting power will also require a tuck in the externus of about one millimeter for each two degrees of imbalance. Two millimeters of fold of muscle is the minimal amount which may be clamped and sutured.

From these illustrative examples it will be readily and correctly inferred that for low degrees of heterophoria, when the tendinous portion of the muscle only is tucked or folded, a relatively smaller correction is obtained. It is in heterophorias, and particularly exophorias, that instrumental tucking procedures permit finer adjustments and corrections. Landolt firmly advocated operation on both eyes unless one was dealing with marked strabismus involving an amblyopic eye. This rule applies particularly to the correction of heterophorias and alternating deviations.

In convergent squint, seven millimeters represents about the actual

maximum corrections is compiled from our recorded experience in tucking individual muscles without tenotomy of the opposing muscle:

Inferior rectus, maximum correction obtained—12°.

Internal rectus, maximum correction obtained—12°.

External rectus, maximum correction obtained—16°.

When it was desired to secure a greater correction than could be obtained with a tucking instrument, we have found that twenty degrees could be secured on either the internal or external rectus by a modified Lagleyze method, with silk sutures tied outside the conjunctiva. The objection to this procedure is the puckering of the muscle which results. It is not desirable to attempt higher than a twenty degree correction on a single muscle. Higher degrees of correction may always be obtained by operation upon the opposing muscle. If tenotomy of all central fibers of an opposing muscle is done, leaving only the extreme lateral attachments, the effect of tucking is augmented by about five degrees. In our series no

complete tenotomies of the vertical or internal recti have been done. In several instances in which central tenotomy of the externus has accompanied tucking of an internus, or was done later, the effect of tucking was not increased more than five degrees. Experience was the same when tenotomy accompanied resection after the method of Reese.

should precede tucking. By recessing the opponent almost to the equator and tucking the external rectus to the utmost degree, it has been found possible to correct a convergent strabismus of thirty-five degrees. It has not been possible to equal this degree of correction by reversing this procedure with a divergent strabismus, and it is not advisable to attempt correction of over

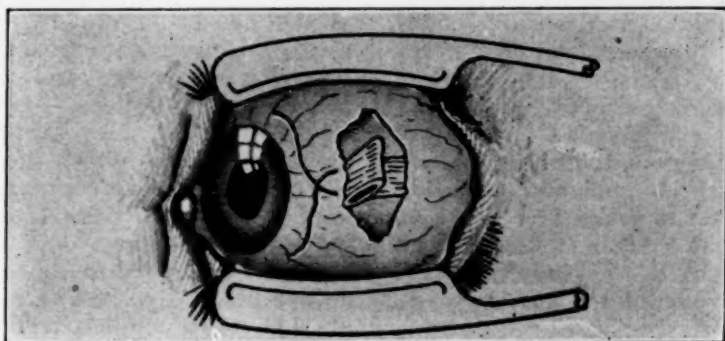


Fig. 5 (Burch and Grant). Silk suture tied outside the conjunctiva.

Recession has been found to be a valuable aid in muscle tucking. R. J. Curdy, in 1916, proposed recession of the opponent with use of the scleral suture to accompany advancement. He advocated equal advancement and recession—that is, if one muscle was advanced three millimeters, the other should be recessed by an equal amount. This principle, as recently explained by Rönne*, is proving quite correct in practice, especially when dealing with a monocular strabismus of high degree and if the operation is confined to one eye. When the method of Curdy as modified by Wilkinson (figure 3) is employed, one millimeter of recession is equal to almost four degrees of correction, but results are not uniformly accurate.

If recession precedes the tucking operation the effect of the latter is considerably increased. In all cases of monocular strabismus of high degree, when one desires the highest possible correction with operation on one eye alone, recession of the opposing muscle

thirty degrees of divergent deviation by a combined operation upon one eye alone.

In alternating strabismus, the tucking should always be done equally upon the two eyes. Thirty degrees of deviation has been corrected in alternating convergent strabismus by tucking both external recti without tenotomy of the interni. In such cases, when tucking both external recti, the opponents have not been tenotomized or recessed at the same time, and, if required, this further procedure has been done later. In alternating convergent deviations, application of the Curdy-Rönne principle, above mentioned, in actual practice sometimes results in overcorrection. On the contrary, in divergent deviations no double tuckings of the internal recti have been done without tenotomy or recession of the externi.

In general, the following examples show some approximate procedures for various muscular imbalances:

Exophoria, 12° distance, 20° near: Tuck each internal rectus 3 mm. or tuck one external rectus 3 mm. and recess internal rectus 2 mm.

* Archives of Ophthalmology, 1927, volume 56, page 428.

Esophoria, 12° distance, 20° near: Tuck each external rectus 3 mm. and leave the interni alone.

Hyperphoria, 12°: Tuck one inferior rectus 4 mm. or recess one superior or one inferior rectus 3 mm. Instrumental tucking of the superior rectus is not practical.

Alternating convergent strabismus: 20°, tuck each external rectus 5 mm.; 30°, tuck each external rectus 7 mm.; 40°, tuck each external rectus 7 mm.; and recess internal recti later if necessary.

Monocular convergent strabismus: 20°, tuck external rectus 4 mm. and recess internal opponent 3 mm.; 30°, tuck external rectus 6 mm. and recess internal rectus 3 to 4 mm.; 40°, tuck external rectus as much as possible and recess internal 4 to 5 mm.; operating on other eye later if necessary.

Alternating divergent strabismus: 20°, tuck each internal rectus ad maximum and recess later if necessary; 30°, tuck each internal rectus ad maximum and recess each external rectus 3 mm.

Monocular divergent strabismus: 20°, tuck internal rectus 5 mm. and recess external rectus 4 mm.; 30°, tuck internal rectus as much as possible and recess external rectus almost to equator.

Paralytic strabismus: Tucking is not a practical procedure in paralysis. Resection of as much of the flaccid muscle as possible, combined with recession, gives the best results.

Advantages of tucking over other procedures

Chief of the advantages which recommend the tucking operation are its safety and ease of performance. This makes it a valuable procedure for the surgeon who does not operate daily. It seems unnecessary to argue for preservation of the original insertion whenever this is possible, but it is a real advantage, obtained only by this method of shortening. After tenectomy or advancement patients are occasionally seen in whom definite cyclophoria or vertical deviation has resulted in the operated eye from faulty insertion, mal-

adjustment, or cutting out or slipping of the sutures. Silk sutures securely tied in the tendon stump do not easily become loosened or cut out, and the correction obtained when the operation is completed is more permanent than by any other method. No suture troubles have been observed by us after tucking with the method now used.

The disagreeable hump previously encountered is no longer an objection. With buried silk, and by turning the muscle and tendon backward, the tucked tendon soon atrophies. Prominence is rarely noticed after the second week. Moreover, the ability to avoid removal of sutures which often requires a second anesthetic in the case of children is a decided advantage.

Practically the only argument against this procedure has been the inability of the operator to estimate the amount of tendon stretching. If the figures given in our estimates are followed the amount of correction obtained is very satisfactory, and if a proper allowance is made for stretching the results are what they are planned to be. One may obtain almost as high a correction as by resection and one need not fear overcorrection unless the opposing muscle is tenotomized too freely or the recession suture is omitted. Errors in judgment are usually on the side of safety.

We believe that the tucking procedure is the method of choice for all heterophorias where finer corrections are necessary in overcoming insufficient action of certain paired or single muscles. In all cases in young children, not only because of its safety but because surgical correction is possible at an earlier age, when there is greater probability of obtaining binocular fixation and sometimes good fusion power, tucking is an advantageous operation. This is especially true in alternating squints, which sometimes later become monocular deviations. In these cases the operation should be done on both eyes equally or nearly so. It is a desirable operation in monocular strabismus not exceeding twenty degrees. For deviations higher than twenty degrees,

tucking should usually be combined with recession. If sufficient correction is not obtained by both operations upon one eye alone, the other eye should have a supplemental correction at a later period. The use of some form of instrument is advisable, and after try-

ing out nearly all the types designed the present model, manufactured by Victor Mueller and Company of Chicago, has proved most satisfactory.

(Note: In its original presentation, this paper was illustrated by moving pictures of actual tucking operations.)

THE ESTIMATION OF THE TOTAL REFRACTIVE ERROR WITHOUT A CYCLOPLEGIC

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Under the title of cyclodamia the author describes a special method of refraction in which the probable total error is ascertained without cycloplegia, by the expedient of discovering the spherical refractive component which (combined with the approximate astigmatic correction) barely yields vision of 6/60, and taking 1.50 D. sphere from this lens combination. Read before the American Academy of Ophthalmology and Otolaryngology, October 27 to 31, 1930.

The presentation of a method of refraction requires more detail than is interesting to a general assembly. For this reason, when the writer was invited to discuss his method of estimating the total error without cycloplegia at this meeting, and to demonstrate its practice in the teaching course of the American Academy of Ophthalmology and Otolaryngology, it seemed best to outline only the theory of the method in the meeting, so as to confine as much of the detail as possible to the description of the method which is included in the paper for reference. The paper will therefore consist of: (1) A brief discussion of the control of accommodation by fogging and by cyclodamic methods. (2) The story of how cyclodamia developed, including how its novel but necessary methods (a) of obtaining the maximum accommodative relaxation possible, and (b) of measuring the error thereby revealed without lessening such relaxation, were suggested by the analysis of everyday observations; (3) the description of the method as practically applied; and (4) the writer's estimate of its reliability.

(1) **Accommodative control:** The interference of the accommodation makes the measurement of refractive errors quite inaccurate, except in old people, unless the measurement is made under a large degree of accommodative control. There are, essentially, only two ways of obtaining such control. One is paralysis of the ciliary muscle by a cycloplegic drug, which obtains absolute control of the accommodation by abolishing it. The other is overcorrection with convex lenses, which withdraws most of the visual stimulus to

accommodative action, and encourages accommodative relaxation by allowing better vision only as relaxation occurs. The greater the relaxation, the greater is the control established, total relaxation being equivalent to complete control. Since the chief function of the ciliary muscle is to provide better vision by appropriate contraction and relaxation (most of which is involuntary), overcorrection usually induces relaxation but does not force it. The control afforded by overcorrection is therefore passive, and, though often adequate, is more variable, less complete and less certainly obtained than is that of cycloplegia. The amount of control obtained is indicated to some extent by the amount of relaxation, so that whenever overcorrection does not induce good relaxation control is uncertain.

The amount of relaxation induced by overcorrection has several factors. One of these is the relaxability of the ciliary muscle, which is governed more by the amount of accommodation habitually used than by the total power of the accommodation. Thus in some young hyperopic individuals who do little close work, powerful ciliary muscles sometimes relax so easily and greatly under overcorrection as to reveal most or all of the total error; while in some overworked hyperopic presbyopic patients, whose total accommodative power is much less, overcorrection may induce little or no relaxation. Nonrelaxability of the accommodation therefore is often a better indication of the need of a cycloplegic than is the age of the patient. Other factors in the amount of relaxation induced are the

exact ways in which the overcorrection is applied, the amount of relaxation really sought, and the means used to measure the refractive error.

Though the principle of overcorrection is the basis of all noncycloplegic refraction which attempts to control accommodation, various applications of this principle have resulted in several methods. Most of these methods, of which simple fogging is typical, attempt to obtain only so much relaxation as will reveal and measure that part of the total error which is to be corrected by glasses. This is done by the strongest convex or weakest concave lenses with which maximum vision can be readily obtained, no more accommodative relaxation being secured than the amount which maximum vision easily permits.

The cyclodamic method, in sharp distinction from the others, seeks all the relaxation possible, and attempts to eliminate the effect of accommodation altogether, so as to reveal and measure the total error itself. This is done by minute attention to detail in the arrangement of all the conditions of overcorrection so as to encourage continuous and cumulative relaxation to the point where relaxation is nearly or quite total. When such an amount of relaxation is not incompatible with sharp vision, the error may be measured as in fogging, but this is always uncertain. The error, therefore, has to be measured by the strongest convex or weakest concave lenses with which the maximum relaxation obtainable is observed, either during such skiascopy with distant fixation or during such subjective tests under blurred vision as afford no stimulus to accommodative action.

Only in those cases in which the maximum relaxation observable is found or confirmed by fogging can we be sure that sharp distant vision has not excited any accommodative action whatsoever. Since the measurement is made at the instant of maximum relaxation, whenever that occurs, it is the closest approximation to the total error obtainable without a cycloplegic.

While all refraction methods give much the same measurement when accommodation is very weak or absent, and all except cycloplegia are unreliable in the presence of real accommodative spasticity, they obtain widely different amounts of control when accommodation is strong and active, sluggish in relaxation, weakly rigid, or stimulated by sharp vision, and thus they reveal widely different amounts of error. Some of these amounts are definite enough to have received names.

(a) The refractive error measured without any accommodative control whatever is called the manifest or apparent error. This is so variable and uncertain a part of the total real error that it is measured only because the amount by which it differs from the total error affords information about accommodative behavior which is often needed in ordering correction.

(b) The error revealed and measured by the methods of the fogging class is called the full manifest or apparent error. This is usually about the amount which should be corrected, but is not dependably so in young people unless its relation to the real error is known.

(c) The refractive error revealed when cyclodamic methods are used to bring about the maximum accommodative relaxation which can be measured by sharp vision may be called the maximum apparent error. This is often considerably greater than the full apparent error revealed by simple fogging, and is close to the real error in so many cases that it may be used as a basis for determining very accurate practical correction, except in cases (which are quite common) in which considerable habit accommodation is inseparably associated with sharp vision. Such cases cannot be recognized by sharp vision tests.

(d) The error revealed and measured by methods of the cyclodamic class, where the greatest relaxation obtained under skiascopy, blurred vision, or fogging is the standard of measurement, may be called the approximate total or real error.

(e) The refractive error measured

under cycloplegia is called the static error. This differs from the total real error of the normal eye by the amount of error which is corrected by the minimal tonus of the ciliary muscle. Since measurement under cycloplegia is the only measurement which is always exactly the same under all conditions, it is the standard by which the accuracy of all other methods is gauged. It is quite undependable, however, unless cycloplegic paralysis is known to be absolutely complete.

Entirely dependable refraction requires measurement of the total or real error, of the full apparent error, and of the manifest error. Three distinct types of examination, under absolutely different conditions of accommodation, are necessary to obtain these measurements. The first type of examination measures the real error while the effect of the accommodation is eliminated, either totally by cycloplegia, or approximately by cyclodamia when it obtains good accommodative relaxation. The second type of examination determines the strongest lenses which do not blur sharp vision, and thus requires normal accommodative activity under the more moderate restraint which fogging affords. This examination is called postcycloplegic or postcyclodamic when it follows a first type examination, but is always essentially fogging in principle. The third type of examination requires the presence of normal accommodative activity, either uncontrolled or without irksome restraint. It consists of the fine subjective tests which measure the manifest error and the visual acuity, and which often determine the exact cylindrical correction. These examinations will hereafter be called first type, second type, and so on, when referred to in this paper. They are best made in the order mentioned, so that knowledge of the real error may guide the examinations in which accommodative behavior is studied.

(2) How cyclodamia developed:

There are so many young people whom, for various reasons, one would like to refract without a cycloplegic that if some method of eliminating accom-

modative interference and approximating the total error dependably could be found it would be very useful. The first hint that such a method was possible came to the writer during the draft examinations of the World War, when more dependence had to be placed upon objective than upon subjective methods of refraction, and unusual subjective checks which the draftee could not anticipate and be coached for had to be devised, because of occasional malingerers with the hope of entering or evading service unfairly.

The observation that a person with myopia of 1.50 D. usually sees about 6/60 suggested tests under blurred vision, some of which proved useful. By combining these tests with distant fixation skiascopy, a crude but rapid method of roughly estimating the total error was worked out and used in several thousand cases for checking the visual acuity which the total error should allow against the visual acuity claimed. During this unusual experience the observation was made that when cycloplegia was not used the total refractive error could often be estimated more dependably by skiascopy checked by blurred vision than by sharp vision alone. This was the germ of cyclodamia.

Evidence confirming this observation was later afforded by a study of the difference between the amount of error revealed by the refraction method known as "combined skiascopy and fogging" and that revealed by subsequent cycloplegia. This method begins with skiascopy with distant fixation through lenses in a trial frame over both eyes, and goes over to fogging while the accommodation is still relaxed from the skiascopy, starting the fogging under the skiascopic lenses without removing the correction for the working distance. In the writer's use of this method, the lenses are then weakened equally until maximum vision is obtained, before testing either eye separately.

The error revealed by this method was shown by cycloplegic check to be close to the total error when good skiascopic relaxation occurred and was

maintained through the fogging. In many cases, however, the full skiascopic relaxation was not maintained, and the strongest lens with which the patient obtained maximum vision was weaker than that indicated by the skiascopy, sometimes much weaker. In these cases cycloplegia showed that the skiascopy was more accurate than the fogging, that the greatest amount of relaxation observed during the skiascopy was quite often practically total relaxation, and that unless the fogging confirmed the maximum skiascopic relaxation it did not reveal the approximate total error.

The inferences from this study were:

(a) In some people there is so close a habit association between sharp vision and use of accommodation that their complete dissociation is impossible without a cycloplegic. (b) Sharp vision actually stimulates accommodation in such people and so makes full relaxation impossible. (c) The chief reason why full skiascopic relaxation in such people is not maintained throughout the fogging is the employment of sharp vision as the criterion of measurement. (d) Sharp vision cannot, therefore, be used in such people for estimation of the total error, unless the accommodation is paralyzed; and, conversely, subjective measurement of the total error is impossible in such people without cycloplegia, unless it can be made without the use of sharp vision.

These inferences, together with the draft experience, suggested experiment as to the possibility of measuring refractive errors subjectively by such degrees of blurred vision as afford no stimulus to accommodative action. It was found not only that the great accommodative relaxation so often observed during skiascopy with distant fixation could be almost always fully maintained, and sometimes even increased, so long as the vision of both eyes was kept blurred to about 6/60, but that, if the astigmatism was previously corrected, the spherical error revealed by such relaxation could be quite accurately measured by deducting 1.50 D. from such overcorrection

as blurred the vision to just 6/60. It was also found that the limit of accommodative relaxation was much more frequently reached when sharp vision was not allowed at all, and that the error revealed by this limit was not the full apparent error revealed by other noncycloplegic methods but was a reliable approximation to the total error whenever relaxation was good.

A first type, noncycloplegic method of refraction, based upon these studies, was thus developed by the writer, and has now been used routinely for several years. This method was described in the American Journal of Ophthalmology for December, 1926, as "refraction under cyclodamia". Cyclodamia literally means well controlled accommodation, the term being derived from the Greek *κυκλος*, which has come to stand for the ciliary muscle, and *δαμναω*, which is the word the old Greeks used for the taming and control of their wild horses.

Since noncycloplegic control of accommodation is only obtained when accommodative relaxation is induced by overcorrection, well controlled accommodation means accommodation at the point of the maximum relaxation obtainable. The terms "cyclodamia" and "maximum accommodative relaxation" may therefore be used interchangeably in their strict sense. "Cyclodamia" is also frequently used in a more general way to mean the "method of obtaining maximum accommodative relaxation and of measuring the error thereby revealed." Its usage, as well as its derivation, thus follows the pattern of "cycloplegia", which literally means paralyzed accommodation, but is used in a general way also for the method of obtaining such paralysis and of measuring the error it reveals.

In the description given in 1926, the fact that the maximum accommodative relaxation obtainable was frequently greater than could be maintained when sharp vision was allowed, and that the error which it then revealed could only be measured by skiascopy and by blurred vision, was not made clear enough. Cyclodamia was therefore con-

fused with meticulous fogging. Cyclo-damic control of accommodation, however, is not limited by sharp vision, and it therefore obtains total or nearly total relaxation in many more cases than does even meticulous fogging. Total relaxation theoretically reveals the total error exactly, since it is less than the relaxation of cycloplegic paralysis only by the normal tonus of the ciliary muscle.

Maximum accommodative relaxation may be defined, for the purposes of this paper, as the largest amount of accommodative relaxation that can possibly be induced, during a comparatively short examination, by the continuous action of really favorable conditions. That is, it is the limit of obtainable relaxation. Since maximum accommodative relaxation is always required if the total error is to be approximated closely, we must consider: (1) the conditions under which such relaxation most surely occurs; (2) the methods of measuring the refractive error revealed by such relaxation which the maintenance of those conditions makes necessary; (3) the simplest practical way of securing those conditions and applying those methods in the examination of an individual patient; (4) the conditions under which this measurement is dependable.

(a) Conditions under which maximum accommodative relaxation most surely occurs

Maximum relaxation is no more a natural state of the eyes, unless perhaps during sleep and in high myopia, than is cycloplegia, and it does not come by itself in a refraction examination but has to be carefully induced. While more or less relaxation is often easily obtained by ordinary fogging, maximum relaxation is only regularly secured by arrangement of all the minute details of the examination in such a way as to provide the most favorable conditions for it to occur. Many of these conditions were suggested by common observations.

One such observation is that if the strongest plus sphere with which a hy-

peropic patient gets maximum vision is determined for each eye while the other is covered by a screen, he will usually get maximum vision with somewhat stronger spheres when both eyes are tested together. This suggests that when maximum relaxation is sought the eyes should always be tested together, under overcorrecting spheres at all times; that no screen should be used, except for an instant when it is necessary to determine which eye sees the better at that moment; and that when one eye has to be excluded for a longer time it should be excluded by the addition of a still stronger sphere instead of by a cover or screen.

It is another common observation that when skiascopy shows that lenses in the trial frame over both eyes just cause reversal while the patient looks at the examiner, they will be too weak when the patient looks at a distant object, unless the accommodation is paralyzed. Maximum relaxation therefore requires that skiascopy be done with a distant point of fixation, just as in combined skiascopy and fogging, and that lenses in a trial frame over both eyes be used, instead of lens batteries which leave the other eye without overcorrection.

It is also observed that, when skiascopy under such conditions is somewhat prolonged after reversal has been obtained, further marked relaxation not infrequently occurs; and that when one is called away for a moment from a patient who is wearing overcorrecting lenses which allow him about 6/60 vision in each eye, upon return his vision through those lenses will often be much better; though if he has removed the lenses, when they are replaced he may not be able to see even the 6/60 that he saw before. This suggests that maximum relaxation is favored by the continuous action of overcorrecting lenses over both eyes.

It is well known, though the great significance of the fact is not generally appreciated, that a patient with myopia of 1.50 D., if not allowed to improve vision by lid action, usually sees about 6/60; also that if plus 1.50 sphere be

added to any full cycloplegic correction, after the effect of the cycloplegic is entirely over, it will reduce vision to about 6/60, though plus 2.25 addition is required to do this while the effect of the cycloplegic is complete, the 0.75 difference being due to the normal tonus of the ciliary muscle.

The subtraction of plus 1.50 sphere from such overcorrection as allows a patient not under a cycloplegic just 6/60 vision should, therefore, yield the measure of his spherical refractive error at that moment, and should also allow him normal vision if the amount of accommodation used remains the same at both the 6/60 and the 6/6 levels. Experiment has shown that this is a quite accurate measure of his spherical refractive error at that moment, but that it allows normal vision regularly only in old people and quite irregularly in others. This is evidence that sharp distant vision often involves some involuntary accommodative action beyond the normal 0.75 tonus of the ciliary muscle, and so defeats maximum accommodative relaxation; that, when the latter is sought, sharp vision must be prevented; and that sharp vision cannot therefore be permitted in either eye, since accommodation in one eye causes accommodation in both.

Experiment has shown that maximum accommodative relaxation is most apt to occur either during skiascopy with distant fixation, or during such subjective tests as keep the patient looking with both eyes at distant objects or letters through lenses which blur the vision to an amount to which the patient is so unaccustomed that no stimulus to involuntary habit accommodation is provided, but an amount of blur which does not entirely prevent some recognition. The exact amount of blurring most favorable to maximum accommodative relaxation varies somewhat in different patients, but is most often found at about the 6/60 level of blurred vision for both eyes or between that and the 6/12 level.

When maximum accommodative relaxation is once obtained, it usually persists at both the 6/60 and the 6/12 lev-

els, in some cases even at the 6/6 level, though it is seldom originally obtained there in young people. It is wise, however, not to permit vision better than 6/12 until the first type examination is over, since slightly blurred vision, such as from 6/6 to 6/10, does stimulate accommodation at times, especially in poor light. A similar condition is the slight blurring of full correction at the movies. Blurred vision at higher, unaccustomed levels does not ordinarily stimulate accommodation at all but tends to promote relaxation. The only exception to this which has been noted is that, in a few people whom such blurring annoys, relaxation may be a little hard to start, and requires good light, a little time, and perhaps a little less blurring, so that some letters are sufficiently easy to recognize for the patient to make the effort to recognize them which he would not make before. Once relaxation begins, however, blurring regularly promotes it.

In such ways the conditions which most favor maximum accommodative relaxation have been worked out. They may be briefly summarized as excluding all tests which tend to stimulate accommodative action, especially all subjective tests in which the criterion is sharp vision, even though such tests do not stimulate accommodative action in all persons. They exclude all tests of one eye alone, at any level of vision, unless the other eye is excluded by a greater amount of overcorrection instead of by a screen. They require uninterrupted overcorrection of both eyes of definite and measurable amounts, both during skiascopy with distant fixation, and during all subjective tests. They further require arrangement of all conditions of all tests so as to favor continuous and cumulative relaxation.

(b) Methods of measurement necessary under maximum accommodative relaxation

The maintenance of the conditions under which maximum accommodative relaxation occurs determines what methods of measuring the refractive error which it reveals may be used and

what may not. Among objective methods we are practically limited to skiascopy with distant fixation for measurement of both spherical and cylindrical errors. Accurate keratometry, however, gives an approximation to the cylindrical error in both axis and amount which greatly simplifies and shortens the skiascopic examination and makes it more readily exact; or, what is equally helpful, it indicates that there is little or no astigmatism. An extremely brief ophthalmoscopy, using minimum illumination, also gives a rough but useful hint as to the spherical error, and as to any disturbances in the media or retina which may interfere with measurement. Both should be done, however, before accommodative relaxation is sought, so that, once started, its continuity may not be interrupted.

The same conditions likewise limit our subjective methods of measuring the spherical error to those which demand visual tests only at levels of blurred vision which do not ordinarily excite habitual accommodative action, such as those at 6/60 and at 6/12 and sometimes between. No subjective method for measuring the cylindrical error under blurred vision has been devised.

Since maximum accommodative relaxation occurs with any regularity only under overcorrection, and all measurements of the spherical error have to be made under that overcorrection, the amount of error which such relaxation reveals cannot be measured directly by the sphere under which it is observed, but always has to be measured by that sphere less a certain correction. If observed under skiascopy, the correction to be subtracted is, of course, that for the working distance, namely 1.00 D. for 1 meter, 1.50 D. for 2/3 meter, 2.00 D. for 0.5 meter, and so on. If observed during subjective tests, the correction to be subtracted is that which blurs absolutely emmetropic vision to the same level as that at which the test was made, namely, 1.50 for 6/60 (20/200), 1.25 for 6/30 (20/100), 1.00 for 6/20 (20/66), 0.75

for 6/15 (20/50), 0.50 for 6/12 (20/40). These corrections agree exactly with Thorington's table for vision under cycloplegia, if the normal tonus of the ciliary muscle is taken as 0.75, and have proved as accurate as the correction for the working distance in skiascopy. The idea of a correction to be applied in subjective tests is less familiar than is that of a correction in objective tests, though quite as logical. It is apparently the only way by which sharp vision, with its stimulus to accommodation, can be replaced in subjective measurement.

The methods of measuring the cylindrical or astigmatic error require more detailed description. Under cycloplegia both the cylindrical and the spherical error are constants, that is, they are not variable and do not change in amount while full cycloplegia lasts. Without a cycloplegic the spherical error is almost always a variable, one limit of which we are trying to measure. The cylindrical error, however, may be considered as a constant, though there are occasional important exceptions.

It is always much easier to measure the limit of variability in the sphere if we first eliminate the astigmatic constant. We therefore measure the cylindrical error first, so that we may put the correction for it into the trial frame, and thereby convert our patient's refractive error into simple hyperopia or myopia while maximum accommodative relaxation is sought. Considerable accuracy in this measurement is necessary in both amount and axis, in order that the cylindrical correction may not leave enough uncorrected astigmatism to disturb the measurement of the spherical error.

In finding this correction, we cannot, of course, use the fine, exact subjective tests with charts, dials, trial lenses, and cross cylinders which are so useful under cycloplegia and in third type examinations, since all of them tend to stimulate accommodative action. We have, therefore, to be content with only objective measurement of the astigmatic error at this stage, though as ac-

curate as we can make it, and postpone all subjective measurement to the second and third type examinations.

Such objective measurement is perhaps most exactly made by first accurately measuring the corneal astigmatism with a good keratometer, such as the 1920 Meyrowitz model; then putting the cylinders thereby indicated into the trial frame, together with overstrong spheres, and accurately skiascoping, first finding the spheres which bring reversal in the weaker meridian, then changing the cylinders from the correction indicated by the keratometer so far as is necessary to correct the total astigmatism shown by skiascopy. Since the corneal astigmatism is almost always much the largest factor in the total astigmatism, and very often the only one, such changes are usually quite small.

This objective correction of the total astigmatism, when later checked by the fine subjective tests of the third type examination, is usually found to be a very close correction, and not infrequently closer to that found under a subsequent cycloplegia (since it is made under more nearly the same conditions) than is the correction indicated by second and third type examinations alone. This objective correction is therefore left in the trial frame without further change or attention during all the efforts of the first type examination to obtain maximum accommodative relaxation.

(3) The refraction of a patient under maximum accommodative relaxation

While the history may be taken by an assistant, no preliminary test of vision or refraction which may possibly stimulate accommodative action should precede the first type examination. The latter begins with an inquiry by the examiner as to the patient's chief symptoms and their relation to use of the eyes and to general health. Any other necessary facts will be volunteered by the patient or will be suggested by the behavior of the accommodation during the examination. An accurate keratometer reading by the

examiner, a very brief ophthalmoscopic examination, and a record of the glasses worn complete the preliminary data. The total astigmatism is then determined as a variation from the corneal astigmatism by skiascopy with distant fixation, as previously described, and we are ready to go ahead with the induction of maximum accommodative relaxation and the measurement of the spherical error which it reveals. This is done in a short but continuous examination with three records.

Both eyes alternately are further skiascoped under the cylindrical correction found, together with overstrong spheres in the trial frame, always with a distant object of fixation in a moderately dark room, until as much accommodative relaxation as possible has been obtained; not only gradual relaxation, but also, if possible, that sudden, greater relaxation which sometimes lasts but a moment. The skiascopy should not be hurried, as a little time has to be allowed for relaxation to occur, but it should not be prolonged unduly. The spheres are meanwhile changed to those which just cause reversal at the moment of greatest relaxation, regardless of when that occurs or whether it is maintained or not. The lens combination then in the trial frame, less correction for the working distance, exactly measures the total error thus far uncovered, and this amount should be recorded as the skiascopic measurement. It saves a change of lenses for the next test, if skiascopy has been done at $2/3$ meter distance, for which the correction is $+1.50$ D.

Without removing the skiascopic lenses, and so giving the relaxed accommodation a chance to become active again, subjective tests of both eyes together are begun, beginning with the lenses then in the trial frame. Since these are $+1.50$ overcorrection of the total error found at the moment of greatest relaxation under skiascopy, if this relaxation is maintained the patient should see just $6/60$ with them, and this is what is usually observed.

In some patients this relaxation is

not maintained and they will not see quite 6/60 at first, while in a few patients more relaxation occurs and they will see better than 6/60, sometimes much better. If the patient does not see 6/60, a little time for relaxation should be allowed.

Many patients say that everything is so blurred that they can see nothing, and they make no effort to see. But, if gently encouraged, told to look away and look back, asked to tell what they think or guess what the big letter is in spite of the blur, they will usually name it correctly. This is sufficient, if they have not seen it before so as to remember it, and if they are unable to name those beneath it. If it becomes evident that the 6/60 letter cannot be named correctly the spheres over both eyes are weakened slightly, each by the same amount, until it is just surely recognizable.

Since both eyes so far have been tested together, we do not yet know whether the patient sees 6/60 with both eyes or with only one. This fact is now determined by covering each eye alternately with a card for an instant; but only for an instant or the accommodation may tighten up and he may not see 6/60 with either eye. If he has seen it with only one eye, that eye is excluded by the addition of a slightly stronger sphere (+0.50 to +1.00 D), while the vision of the other eye is brought to 6/60 by a slight change of sphere.

If the patient sees better than 6/60, either at first or at any time later, the spheres are increased until each eye sees just 6/60. This practically amounts to fogging of both eyes together to 6/60 instead of to 6/6. In changing spheres, one should be put into the trial frame before the other is taken out, as neither eye must be allowed to see at all without overcorrection, even for the instant of changing lenses, during the whole first type examination. The 6/60 letter must also be well illuminated, as accommodation tends to tighten up in poor light.

The 6/60 test is very simple and seldom takes more than two or three min-

utes unless accommodation is very refractory or the patient does not cooperate. It may be briefly summarized as follows: Starting with the skiascopic lenses, 6/60 vision is expected and usually obtained. If vision is not just 6/60 after a minute or two of encouragement, the spheres are changed equally until the 6/60 letter is just surely recognized and no more: first for the two eyes together, then for each eye separately while the other is excluded by a stronger lens. When all the relaxation possible has been obtained and each eye sees just 6/60, the lenses then in the trial frame, less +1.50 D., measure the total error uncovered with 6/60 vision, and this should be recorded as the 6/60 measurement.

A similar test at the 6/12 level of blurred vision completes the first type examination. This ordinarily requires lenses just 1.00 D. weaker than those of the 6/60 test, and so takes very little time. In some cases, however, especially those where good cooperation in the 6/60 test was not obtained, and those in which fatigue is at the point where it aids relaxation and has not reached the point where it defeats it, more relaxation is found at the 6/12 level than at any time before. In any case, the lenses which permit 6/12 vision and no more, less +0.50, are the measure of the total error uncovered by 6/12 vision, and are recorded as the 6/12 measurement.

Comparison of the skiascopic, the 6/60, and the 6/12 records completes the first type examination. In most cases these records are practically the same. If they are not, relaxation has not reached to the same point in each of the three tests. Accommodation must therefore have been used in some of them, perhaps in all, and the approximation of the total error is uncertain. Reexamination under better conditions or recourse to cycloplegia is therefore needed. If neither of these is practicable, that one of the three records which shows the largest amount of error is taken as the closest approximation to the real error so far made.

When the three records agree, accommodative relaxation must have

reached to the same point in all of the tests. It is probable that this point is total relaxation, or very close to it, since any relaxation less than total should be variable, unless there is tonic spasm or rigidity of accommodation which remains absolutely fixed in amount during the varying conditions of the three tests. The latter is extremely improbable when any real amount of relaxation has been obtained. There is also less reason why relaxation, once well started and not limited by the habits of sharp vision, should not go on to total relaxation under favorable conditions than that it should stop at any point short of that.

The agreeing records, when relaxation is good, are therefore considered as a reliable approximation to the total real error. This is then used as a guide in the second and third type examinations just as if it had been made under cycloplegia, with the exception that it must always be less than the static error by the 0.75 average tonus of the ciliary muscle, and by so much more as the maximum relaxation observed may be less than total relaxation, which is usually very little unless relaxation has been poor.

Throughout this first type examination, which usually takes five to ten minutes when one is familiar with it, one must never forget that the amount of spherical error revealed varies with the amount of accommodative relaxation, and that we are interested only in the greatest amount of error observed at any time. We therefore do everything possible to promote relaxation, and watch for the instant at which it is greatest in each of the three tests. The greatest amount of error surely observed, though but for an instant, should not therefore be distrusted. Nor should it be forgotten, during this first type examination, that we are not at all concerned with the amount of error to be corrected. That will be determined later, as a variation from the total error, by the finer subjective tests of the postcycloplegic examination. It is the total error alone which we are here trying to approximate reliably, so as to

avoid the necessity of a cycloplegic. Much confusion results if this is not kept clearly in mind. The cycloplegic examination, therefore, can be and is largely objective, and demands from the patient only: (a) distant fixation during skiascopy; (b) the reading of 6/60 and 6/12 correctly and of 6/30 and 6/10 incorrectly with eyes wide open; and (c) the information as to which eye sees the better when that needs to be known. Since no sharp vision and no choice of lenses is permitted, the cycloplegic examination is essentially a rapid one.

While first type cycloplegic examinations seeking the total error, and the ordinary noncycloplegic examinations seeking the amount of correction to be ordered, have to be made separately and cannot be combined, both because their objectives are different and because they require entirely different states of accommodation, there should be no interval between the two examinations. Measurement under blurred vision is seldom understood by the patient, and he is often rather disappointed until he is allowed maximum vision and the choice between lenses, in the second and third type examinations.

It is therefore usually wise, as soon as the 6/12 measurement is recorded, to proceed with the second type examination at once by removing the 0.50 overcorrection of the 6/12 level and seeing if maximum relaxation can be maintained with maximum vision, as it often can when habit accommodation is not too strong. The usual well known methods of second and third type examination are then used. The spheres are first weakened, if necessary, until maximum visual acuity is obtained. The cylinders are adjusted by fine subjective tests in which cross cylinders are very useful; the manifest error and the visual acuity with and without correction are determined and recorded; the spheres are again strengthened as much as maximum vision surely permits; and the final correction is balanced, if necessary, to give each eye equal conditions of vision. The com-

bination of lenses then in the trial frame is usually the prescription for glasses, unless it does not correct enough of the total error to give almost certain relief from symptoms, or corrects so much more than the full manifest error as probably to remain uncomfortable for the patient beyond the ordinary adjustment period of two to four weeks. The probable effect of any change from the previous correction upon the relation between accommodation and convergence, and upon temporary or permanent phorias, must also be considered. When the amount of previously uncorrected spherical error in young people is large, it is usually better to correct it by degrees than to try to force full correction at once, unless there is urgent need for full correction.

(4) The reliability of cyclodamia in approximating the total error

Unless fogging reveals considerable previously uncorrected error, it is not a dependable guide to adequate correction in young people and in overworked presbyopic individuals. Knowledge of the total error is necessary for real dependability. On the other hand, the total error found under cycloplegia or cyclodamia is not, by itself, a dependable guide to satisfactory correction, except in myopic patients. The right amount of concession to the accommodative habit of a patient can only be found in a postcycloplegic or postcyclodamic fogging examination of that patient, where knowledge of the total error keeps the concession from being more than is surely necessary for ultimate comfort. The right amount is too variable in different patients to be determined by arbitrary rules or upon the basis of a precycloplegic examination.

Since the total error, therefore, is seldom fully corrected, a reliable approximation to it is all that is usually needed for dependability. The method described in this paper affords such an approximation whenever the accommodation is mobile. While the method is, of course, by no means as generally dependable as is thorough atropin cyclo-

plegia, it falls little short of that in the cases where it obtains more relaxation than can be measured by sharp vision. It is more dependable than homatropin cycloplegia as that is perhaps most often used. It is much more dependable than fogging, since it approximates the total error reliably in very many more cases, and since it points out, by failure to obtain relaxation, almost all of the hyperopic cases in which its reliability is uncertain.

Much that is obviously impossible with other noncycloplegic methods is thus practicable with cyclodamia; how much we do not yet know. The only accommodative anomaly affecting distant vision which it does not make evident, and in the presence of which it is therefore most apt to be unreliable, is tonic accommodative spasticity. This, in its very rare active form, is easily recognized by the symptoms. Its passive form is seldom seen except in overworked eyes, where it is essentially a habit accommodation associated with sharp vision which has become so fixed that it will not relax even under the blurring of cyclodamia. This form can only be inferred from the failure to get good relaxation, together with the symptoms and the history. Ordinary habit accommodation, unrelaxable under sharp vision but relaxable under blurred vision, and clonic accommodative spasticity, both of which are much more common than tonic spasticity, do not interfere with cyclodamic control.

The writer, after several years of experience with the cyclodamic method, checked by atropin cycloplegia in many cases, has noted practically no exceptions to its reliability in closely approximating the total error whenever relaxation was good and all its tests agreed. When relaxation was poor, when its tests did not agree, and when it revealed no more error than did fogging, cycloplegic check showed that it was often accurate but not reliably so.

The behavior of the accommodation during a cyclodamic examination usually shows whether a cycloplegic is or is not needed to reveal the total error, as well as to afford other valuable in-

formation. For these reasons routine cyclodamia, with cycloplegia whenever indicated, has proved more satisfactory to the writer than routine dependence upon either. Cyclodamia may, of course, be used as an alternative method when cycloplegia is not desirable. A better way, however, is to use it routinely instead of a preliminary manifest, since it takes little more time and gives much more definite information; and its sureness, smoothness, and rapidity improve greatly with routine use. When its approximation to the total error shows the earmarks of reliability, it should be followed by a balanced fogging for the determination of the correction to be prescribed, just as after cycloplegia. When its reliability seems in any way doubtful, it should be followed by a cycloplegic.

As one learns the possibilities and the limitations of the method by experience, watches its revelation of the anomalies of the accommodation (which are so well described in Duke-Elder's "Practice of refraction" that the chapter there devoted to them should be read by every refractionist), and comes to know the amounts of relaxation to be expected with different kinds and degrees of refractive error, he will find that he needs a cycloplegic much less often.

In the method of estimating the total error and in the theory of cyclodamic control here described, the prevention of all sharp vision with either eye, the subordination of all else to the obtaining of continuous and cumulative accommodative relaxation, the measurement of the error only at the utmost limit of relaxation, the subjective tests under blurred vision with correction for the amount of blurring, and their arrangement (together with the skiascopic part of combined skiascopy and fogging) into a definite method seem comparatively new, since they have heretofore received little attention. On the other hand, all of the facts upon which are based the unusual methods

of measurement necessary if full cyclodamic control is not to be defeated may be found in the textbooks and in the literature.

Summary

Knowledge of the accommodative habit and behavior of every patient is essential to determination of the proper correction of his refractive error. This knowledge is only obtained by comparison of the total error with that part of the error revealed by the fogging and manifest examinations. While the total error may always be measured under cycloplegia, and in some cases only under cycloplegia, it may often be sufficiently closely approximated by the cyclodamic method described in this paper: quite dependably so when good relaxation is obtained and all its tests agree; less dependably so in other cases.

This method secures an amount of accommodative control which is usually greater and always more reliable than that of fogging, and often but slightly less than that of cycloplegia, by making every smallest detail of the examination contribute to the production of maximum accommodative relaxation. The refractive error thereby revealed often has to be measured without the use of sharp vision, which has been shown to prevent maximum relaxation in many young people.

Once the novel principles and methods of cyclodamia are well understood, it is easier and quicker than cycloplegia, and may well replace it in young people as well as old, if recourse is had to cycloplegia whenever relaxation is poor or accommodative behavior is irregular. Since it differs from all other noncycloplegic methods in that the total error is what it reveals or approximates when good relaxation is obtained, it should always be followed by a fogging and manifest examination, and the correction should be determined as a variation from the total error, just as after a cycloplegic.

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THE BARRAQUER CATARACT OPERATION (Modified)

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Some modifications in the Barraquer technique are described, and a number of illustrative cases are recorded, especially with regard to the occasional complications of this procedure. Read before the American Academy of Ophthalmology and Otolaryngology, October 27 to 31, 1930.

An increasing number of ophthalmic surgeons are turning to some form of intracapsular operation or adopting some procedure to do away with the capsule at the time of the extraction.

The erisiphake method was first described by Hulen in 1910, but was popularized by Barraquer. A. S. and L. D. Green¹ modified the apparatus and also the technique by combining expression with it. Barraquer now uses more or less expression with most of his cases.

I presented my technique and arguments in favor of the Barraquer-Green operation before the eye section of the Iowa State Medical Society² in May, 1925, and another article dealing with its advantages in soft cataract in 1927.³ The technique I am now illustrating is the same with slight variations. It is a modification of the techniques of Barraquer and Green.

Focal infections are carefully searched for and eliminated when found. Blood sugar and blood urea are estimated and both reduced if high. Elimination is raised as high as possible. Tension is taken, and if above 28 mm. operation is deferred and treatment instituted or a preliminary iridectomy performed. Silvol or argyrol and also bichloride ointment, 1 to 1,000, are instilled every one or two hours for at least twenty-four hours previous to the operation. Bromides or other sedatives are given the night before and immediately preceding the operation. Care is taken to calm the patient and to teach him deliberate and easy closing of the eyes. He is impressed with the fact that the operation is to be painless and that should he feel pain he is to calmly notify the operator, and that thereupon the operation will be stopped and more

anesthetic used. The morale of the patient is most important. Nothing is more desirable to the surgeon than a placid patient.

Exact technique is accomplished in our practice by having a cataract operating team of five members, each member being trained to care for certain details. Highly skilled and trained assistance is absolutely necessary. The operator himself tests and checks the apparatus. The first assistant controls the lids, watches the sutures and performs other steps without instruction. It is absolutely essential that he do certain steps without delay or direction. The same nurses assist each time and they are familiar with every step of the operation. One assistant stands behind the operator, hands him the erisiphake and takes it out of his hand, and also controls the foot valve. The instrument nurse wears gloves and care is taken not to touch the parts of the instruments entering the eye.

A preliminary iridectomy is performed, in the majority of cases, a week or ten days before the extraction. The

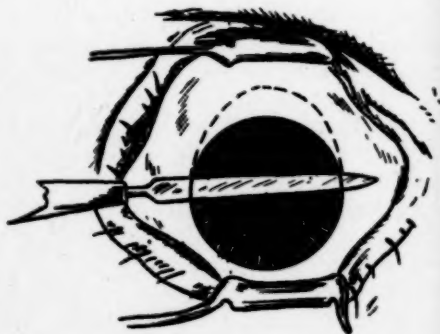


Fig. 1 (Wolfe). Full one-half of cornea. Knife enters and emerges at limbus. Large conjunctival flap. Large preliminary iridectomy.

pupil must be kept well dilated so that synechiae do not form. It is much easier to make a good incision and a broad conjunctival flap where a large preliminary iridectomy has been performed. The knife then never engages the iris at the upper angle, even if the

performed, it can be done at this time. A suture of fine Kalt silk in a Barraquer needle is passed through and through, with a loop of about three-fourths of an inch laid to one side. The ends of the suture are tied and laid to one side so that they can be quickly picked up.

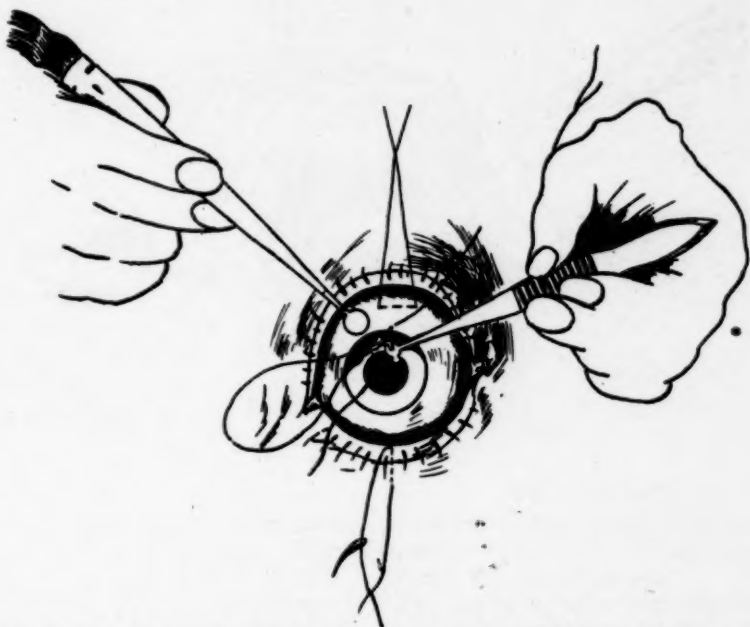


Fig. 2 (Wolfe). Corneal section grasped by forceps, turned back. Vacuum cup placed on lens by direct view.

anterior chamber is shallow. Wide dilatation is often not obtained in elderly people with cataract.

Five percent cocaine is instilled and the lids are injected with two percent novocain. The speculum is introduced, and if the eye is small or deep seated a full canthotomy is performed. A few drops of one-half percent cocaine is injected under the superior rectus and a heavy control suture is inserted as described by McReynolds⁴. I agree with him fully as to its value. If this is placed far up a lid hook is not necessary for the upper lid. The lower lid is controlled by the thumb of the assistant or by a stitch. It is absolutely necessary to make a full one-half section of the cornea (figure 1). One or two drops of five percent cocaine are injected into the anterior chamber. If a preliminary iridectomy has not been

The speculum is then removed.

The second assistant hands the canula to the operator over the right shoulder and watches the tubing to see that it does not bind or pull. He also takes the canula from the operator's hand without further instruction after the cataract is removed. The ball tip forceps already described before the American Academy of Ophthalmology and Otolaryngology at the 1928 meeting⁵ is held in the left hand throughout the operation. The corneal section is grasped with the forceps and turned back (figure 2). The canula is placed exactly on the capsule by direct view and is not watched through the cornea. Thus doing, there is no excuse for catching the iris margins. If the pupil has not responded well to dilatation, a smaller canula is used. The large canula is preferable, and it is much easier

to use where a preliminary iridectomy has been performed. There is less blood in the anterior chamber and the detail is much better.

The operator wears a Beebe loupe and the attachment can be accurately observed as the vacuum is applied. One

will rupture, but seldom before it starts through the wound. When it does this, the capsule and lens débris are delivered so that they seldom require any attention whatever. This accomplishes the same result as an intracapsular extraction. When the proper amount of

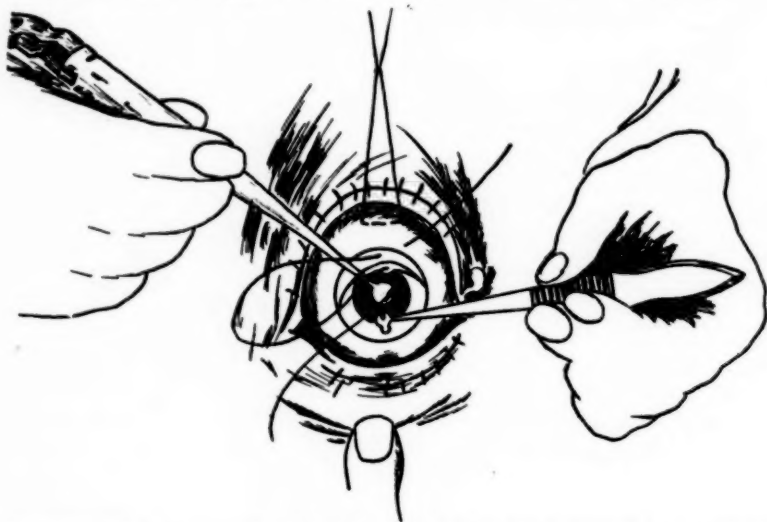


Fig. 3 (Wolfe). After vacuum cup holds capsule firmly, forceps closed, transferred to limbus externally. Ball tip makes counterpressure.

of the assistants reads aloud the amount of vacuum attained. It is varied for different cases. Barraquer uses 55 mm. Hg for soft cataracts and 58 mm. for the others. The canula is then rocked gently from side to side a few times to rupture the suspensory ligament. This rocking also does away with the temporary vacuum produced behind the lens, which would tend to lift the vitreous as well. The corneal section is then released by the forceps, which is then transferred to the globe (figure 3). The ball tip makes counterpressure at the limbus. The amount must be varied to suit the case. As a rule, the younger or better developed patients require considerable counterpressure.

When pressure is first applied, it may be alternated with relaxation, but once the lens starts to be dislocated from the patellar fossa it should be firmly followed as in the Smith technique. If too much lift is made on the canula without counterpressure the capsule

expression and lift are combined the lens will usually appear, upper border first, and will then be lifted out by the canula without further counterpressure. Occasionally the additional lift with less expression causes the erisphake to lose its hold on the capsule before delivery is complete. If so, the first assistant has a Fisher needle ready and assists the lens through the wound. This is more desirable than following the lens with too much expression. If the capsule ruptures, the use of the erisphake is immediately discontinued and the lens is expressed by counterpressure exactly as in the capsulotomy method. A modified Snellen loop is used if vitreous presents before delivery is commenced.

When the pupil is widely dilated and the canula can be placed well down on the lens, this can be tumbled advantageously, as advocated by Cruickshank⁶. The suture is quickly pulled taut and cut, and the eye is immediately closed for ten to fifteen minutes. This

is a very important step. Too much zeal or toilet at this stage may be very harmful. If a bead of vitreous presents, it will usually drop back. Vitreous does not run out. It is either pressed out by the surgeon or the patient. If the lens has been removed in the cap-

the technique is as above described. The central suture is drawn first and tied. The needles of the lateral sutures are then passed through the bulbar conjunctiva above and tied, making a complete closure of the wound (figure 5).

After this procedure patients can sit

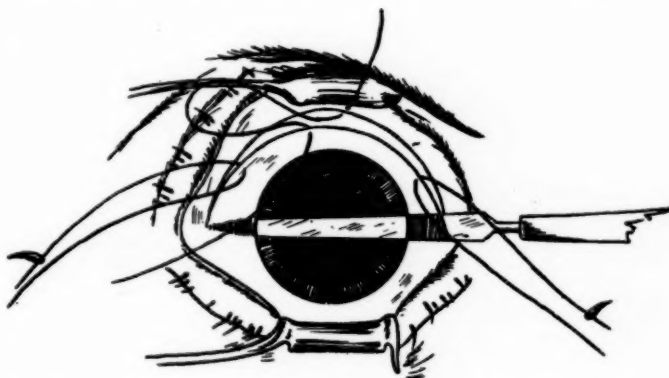


Fig. 4 (Wolfe). Large circular conjunctival flap dissected to limbus. Sutures hold flap up as incision is made. Extraction and central stitch as in figures 2 and 3.

sule, no toilet is necessary except smoothing out the conjunctival flap, after ten or fifteen minutes have elapsed, and instilling the bichloride ointment.

Barraquer does a marginal iridec-tomy after the extraction to prevent iris prolapse. We prefer a large iridec-tomy previous to extraction so that no iris prolapse can occur.

Figure 4 illustrates a variation in the technique that we have used in ob-streperous patients or those who can-not lie on their backs longer than a very few hours, or in cataract with glau-coma. The first step in the operation as thus varied is to dissect a large circular conjunctival flap from above and on the sides. Two sutures are placed on the sides. They are held up alternately like a tent by the assistant, while the incision is made underneath them. The threads are not in the op-erator's way as a forceps would be. The knife comes out above in the sclera in direct view as the flap is held back. The needles are left on the thread of the lateral sutures and are laid to one side. One central stitch is placed as in the original operation. The balance of

up in bed after two to four hours. One patient, who weighed 250 pounds and who had cardiac asthma, had a terrific cough whenever she lay on her back. She was kept reclining only three hours and obtained a good result.

Where glaucoma exists with cata-ract, external filtration can be estab-lished by removing a piece of sclera with the Holth punch underneath the flap (figures 4 and 5) before the lateral sutures are closed. If this is done a water-tight suture or additional sutures are placed.

Figures 6 and 7 are schematic illus-trations of the action of the erisiphake on the cataractous lens.

The eyes are left undisturbed for forty-eight hours and are then in-spected and treated with bichloride ointment. Occasionally we inspect them in twenty-four to thirty-six hours. When they have been inspected for some source of discomfort, a few hours after the operation, we usually have found the anterior chamber reformed with a clear, black pupil. The unoper-ated eye is left uncovered after the third day. Patients can usually be up in a chair on the third day.

Where this conjunctival flap technique (figures 5 and 6) is used, patients can be propped up after a couple of hours, or next day at most. This is a distinct advantage in elderly people, since they do not stand being bedridden and it is well to get them out as early as possible.

At the end of a week the operated eye can be left uncovered part of the time. The rapidity with which the eye clears is very noticeable. Redness and operative hyperemia are usually absent after a week or ten days. Some cases have cleared very rapidly, so that for two patients we have done tentative refractions on the seventh day, for two on the eighth day, and for several on the tenth day, and many have been given glasses to wear on the fourteenth day. There is no lens substance or capsule to be absorbed or to set up secondary inflammation. Postoperative iritis has been conspicuous by its absence. Secondary infection is less likely to occur. There is no danger of a secondary membrane or cataract forming to obstruct vision.

Comment

It is true that with this or any other intracapsular method the average operator is more apt to have a bead of vitreous present or some loss of vitreous occur than with the capsulotomy method, if in the latter he is content merely to deliver the solid nucleus and leave the debris and capsule to be absorbed. If the surgeon attempts to remove the debris either by irrigation or by forceps as most surgeons do, he is just as apt to have vitreous loss as in a careful intracapsular method. H. W. Woodruff⁷ said in discussing the paper of Lloyd Mills: "It would have been better to have performed the Barraquer operation." The patient has a chance of something nearer the ideal at no additional risk. Arnold Knapp⁸ has demonstrated conclusively that iritis, uveitis, and secondary glaucoma are caused by retained capsule and debris.

Colonel Elliot⁹ advises that patients should not defer cataract operation because the other eye still has vision. His

arguments are excellent and well taken.

The Barraquer-Green technique can be used in all uncomplicated types of cataract except where the lens is dislocated. We do not use it in young people. We prefer to do a discission and then remove the lens by the Teall method as described by Dean¹⁰.

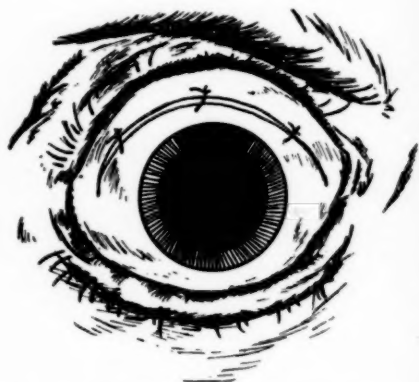


Fig. 5 (Wolfe). After extraction central suture draws flap together. Needles left on lateral sutures as in figure 4 are passed through conjunctiva above; section closed. Additional sutures or water-tight suture used in glaucoma.

Brief analysis of results

Our patients are all private ones and we have been able to keep in touch with most of them. We are disappointed if we do not get vision of 20/30 or better in uncomplicated cataracts, and 20/15 and Jaeger 1 is common. Mrs. S., the patient whose case I reported in my first article¹¹, then seventy-six years old, now eighty-three, still has vision of 20/15 and Jaeger 1.

Our experience with phacoerisis covers a seven-year period in which over two hundred cases have been operated upon. A grouping of cases by hundreds follows:

	A Presentation or loss of vitreous	B Capsule intact	C Retained cap- sule: needling necessary	D Useful vision not obtained	Soft eyes
1st group...	22%	72%	2%	1%	0
2nd group...	17%	81%	3%	4%	1
3rd group...	12%	85%	0	0	0
(No globes lost.)					

The case in group one in which useful vision was not obtained had only light perception on the nasal side of the field before operation. The lens was removed intracapsularly and the eye was found amblyopic except for light. This case had an unusually rapid convalescence, with no vitreous loss,

when we consider that the cases were not selected and that fourteen cases in this group were of highly complicated or pathologic cataract, this changes the complexion of the statistics. If one selected only uncomplicated cataract cases the percentage of visual failures would be greatly altered. Nine of the

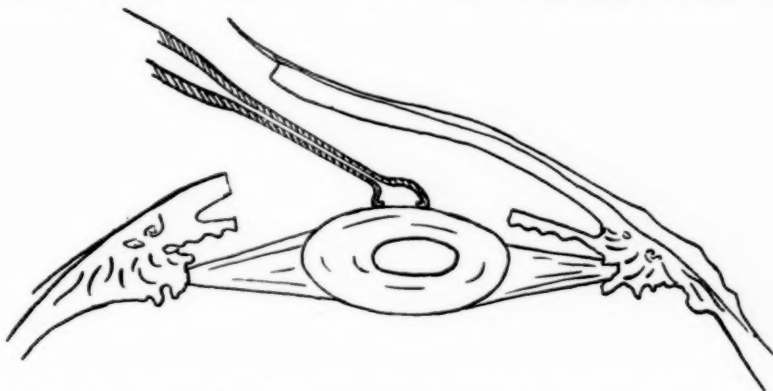


Fig. 6 (Wolfe). (Schematic.) Vacuum cup in anterior chamber placed evenly on lens capsule. Iridectomy above.

and is a perfect-looking eye. In no other instance where the cataract was removed intracapsularly has there been a failure of vision or a secondary inflammation of any kind. In some of our earlier cases considerable vitreous loss occurred, but it had no influence on the visual results. Some of our finest results were in early cases where considerable vitreous was lost. Several elderly patients have since died but they retained their vision to the end. Improvement in technique has reduced the frequency and amount of vitreous loss.

In group two, one soft eye resulted. This case had a history of previous pain and inflammation and had been blind for ten years or more. There was dim light perception, tension 40 mm. (Gradle-Schiötz), at the first examination. The tension was reduced by treatment and preliminary iridectomy. There were several synechiae. The anesthetic was not sufficient, perhaps, and the patient became hysterical and uncontrollable. The cataract was "black". A large vitreous loss occurred.

In group two, the five percent of eyes without useful vision seems large, but

fourteen cases were operated upon successfully and have good vision in spite of the complications. All of the fourteen cases had a history of either inflammation, pain indicating glaucoma, or synechiae indicating a previous iritis, or of all three symptoms together. Five of them had increased tension.

Case two, under D of group two, had hypermature cataract and a history of previous pain and inflammation. Light perception was weak on the temporal side of the field. The pupil dilated poorly, necessitating a small canula. The capsule was ruptured and a solid lens was expressed by pressure. No vitreous presented. The capsule was retained. There was a good pupil and no needling was done. Secondary iritis followed, and convalescence was slow. The result was light perception and hand movements at two feet.

Case three, under D of group two, gave a history of poor general health, "neuralgia", discomfort about the eyes, and gradual loss of vision. There was only light perception. The tension was 45 mm. (Gradle-Schiötz). Shallow anterior chamber, poor incision, capsule ruptured, lens expressed, small retained

capsule. Good pupil, no needling. Slow convalescence, no vitreous loss. Result: light perception.

Case four, under D of group two: History of pain, inflammation. Light perception weak. Tension 32 mm. (Gradle-Schiötz). Shallow anterior chamber. Capsule ruptured. One

dressings were saturated. After this had subsided, the iris was found to have prolapsed into the wound. A very stormy convalescence ensued, complicated by profound iridocyclitis and keratitis, with diffuse corneal opacities. Potassium iodide and mercury were given in large doses for their alterative

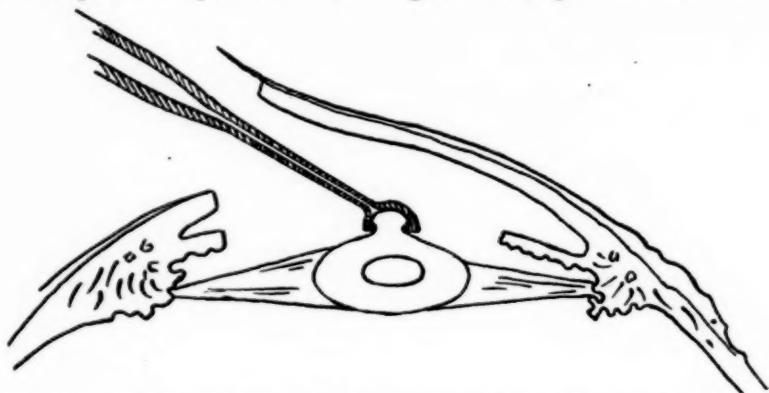


Fig. 7 (Wolfe). (Schematic.) Lens and capsule molded into vacuum cup and held as with forceps.

needling gave fair vision but this gradually failed. Glaucoma. Treatment not followed consistently.

Case five, under D of group two: Male, aged forty-seven years. No eye complications except myopia; very prominent globe. Wore minus 3.00 sphere with minus 2.50 cylinder. Mature cortical diabetic cataract right eye. High blood sugar. Was exceedingly apprehensive and nervous and difficult to control. He had marked contraction and spasm of right facial muscles when excited. A small preliminary iridectomy was performed three weeks previously and the blood sugar reduced. Patient was large and very muscular. The suspensory ligament was tough and the capsule ruptured as the lens was delivered. The wound bled profusely and blood constantly filled the anterior chamber. It was difficult to perform any toilet on account of the patient's extreme nervousness. The morphin and atropin given prior to operation had little effect or rendered him more excitable. The facial spasm started after the incision and continued for several hours. The eye bled continuously for three days, so that the

effect, and were followed by much improvement. A Wheeler incision through the iris was performed, and a good pupil resulted, but the hazy cornea allowed only vision for moving objects at fifteen feet.

Three of the seven successful complicated cases in group two had glaucoma with the cataract. All three had preliminary iridectomy. The lens was removed intracapsularly and good vision resulted, with convalescence only slightly longer than in uncomplicated cases. In group three, five cases complicated by glaucoma were operated on successfully.

In group three, one syphilitic case with cataract, a partly opaque cornea (superficial keratitis improved by treatment), and complete annular synechia was operated upon with the capsule intact. The lens contents was entirely fluid. A preliminary iridectomy had been performed three months previously. The iris was released by sphincterotomy just before the lens was extracted. The patient had seen practically nothing for ten years. Final vision was 20/40. The other eye has the same conditions but with only about

three-fourths synechia and less corneal opacity. Operation will be attempted later.

In a male, aged eighty-six years, whose right eye had been blind sixteen years, a soft morgagnian cataract was removed intracapsularly, with iridectomy just preceding the extraction. Final vision was 20/20 and Jaeger 1.

I wish to state emphatically that in no instance has vitreous loss occurred because of the suction. When a bead presented or a drop or so was lost, it was as a result of the expression. It would have occurred with the combined forceps technique or any other intracapsular technique. It is always less

apt to occur than with the Smith technique, and if controlled as here outlined it need not be feared.

We have had three cases of secondary hernia of the iris occurring some time after the extraction. Two were treated successfully. The third case, one of known glaucoma and cataract, passed from our hands after three months, and the final outcome is unknown. Vision was 15/40 when treatment was discontinued.

One case on which an intracapsular extraction was performed with a history of much previous inflammation had a thin hyaloid membrane. It did not interfere materially with vision.

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BRIEF STATEMENT CONCERNING ONCHOCERCOSIS IN MEXICO

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(Translated by W. H. Crisp)

This very interesting communication as to methods recently adopted for fighting onchocercosis in two states of southern Mexico has a special importance for Central American and other tropical communities. Dr. Silva is chief of the Mexican department of public health.

In the year 1925 we received in Mexico the first notices of the existence in the state of Chiapas of a disease which produced blindness; and since in the neighboring country of Guatemala the onchocercotic infection had been demonstrated for some time in regions lying next to the international boundary, our thoughts were directed to an extension of onchocercosis into our own country.

Physicians sent by the department of public health proved that such was the case and proceeded to install free dispensaries, the purpose of which was to extirpate the filarial cysts which the patients show especially in the hairy skin, and also in the body.

Later we learned that onchocercosis existed likewise in the mountainous region of the state of Oaxaca, and in carrying on an effective campaign against the endemic we encountered various difficulties, one of these being the fact that we had no exact knowledge as to which form of onchocercosis was active; another that we did not know the intermediary; and a third that the infected areas were not well delimited.

Facing this situation, we found it advisable to establish a commission whose duty it would be to clear up the points mentioned, and further—a very important matter—to elucidate the actual mechanism which gave rise to blindness, especially as some authors attributed it to toxic phenomena and almost no one suspected invasion of the eye by the parasites themselves.

In a little less than a year of activity of the investigating commission, the onchocercotic areas were definitely determined. A census of those afflicted

was taken, and we learned that there were about fifteen thousand in Chiapas and about five thousand in Oaxaca. It became manifest that we had to deal with *Onchocerca volvulus* *cæcutiens*. We formed a definite picture of the symptomatology of the disease, which consists fundamentally in the appearance of subcutaneous tumors in the hairy skin and more rarely in the remainder of the body; in a mild elephantiasis of the skin of the face, which assumes an olive-green tinge; and in ocular manifestations which take the form of punctate keratitis and plastic iritis. The keratitis may develop into complete infiltration of the cornea, with loss of visual acuity, and the iritis causes seclusion and occlusion of the pupil. The background of the eye is normal.

By means of anatomopathological studies, in which we made use of eyes the vision of which had been lost, it became clear that the microfilarias penetrate the eye, and that it is they which are directly responsible for the ocular symptomatology, a fact which was unknown or at least had not been demonstrated previously.

Since in Africa onchocercosis is transmitted by *Simulium demnosum*, the commission determined to make a study of the sand flies in the areas invaded by onchocercosis, and it was completely demonstrated that among our people *Simulium avidum*, *mooseri*, and *ochraceum* were responsible for the disease.

While these various studies were being made, we had a dispensary in operation in Chiapas and another in Oaxaca, to get rid of the cysts, which we were

assured by the Guatemalan physicians was the best treatment for onchocercosis.

Having learned the greater part of the obscure facts with regard to filariasis, we organized for this year, and there are in full activity, three sanitary brigades for the state of Chiapas and one for the state of Oaxaca; each of these being composed of a physician, a technical assistant, a male nurse, and a male servant, and being provided with all the necessary materials to undertake the work of extirpation of cysts, which as a matter of fact has so far yielded the best therapeutic results.

The dominant idea of this campaign has been, not to expect, as we formerly used to, that the patients would seek treatment, but to reverse the procedure, and to have our personnel seek the patients.

As our brigades can only travel in the infected areas in the dry months, and it is necessary to discontinue the work during the rainy season, we requested the proprietors of the large coffee estates to take personal charge of plans for continuing the extirpation of the cysts after the withdrawal of our brigades, which it was understood would return to their task during the next dry season.

Furthermore, knowing the biology of the species of fly which transmits onchocercosis, we established among the proprietors of the farming estates the necessary regulations for preventing the procreation of carriers, and an entomologist travels the infected areas with the brigades, in order to insure the cleanliness of ditches, canals, streamlets, and so on; further we have required that copper screening should be placed in doors and windows and other necessary means adopted to prevent the breeding of the sand flies and their access to workmen on the coffee estates.

The work of publication of ideas with regard to onchocercosis, its dangers, and the means of preventing infection has not been neglected, although no great importance has been attached to it.

So far we cannot speak of results of the campaign, since it has hardly begun, but inasmuch as it rests upon a scientific knowledge of the disease and approaches the problem from the double point of view of patient and carrier, we shall doubtless see good results in the course of a few years of uninterrupted work.

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THE USE OF EPINEPHRIN IN PROGRESSIVE MYOPIA

Further report

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Further experience has confirmed the author's previous impression that persistent use of epinephrin solution in the eyes tends to inhibit the progressive development of myopia. Read before the Section on Ophthalmology of the American Medical Association, June 23 to 27, 1930.

Three years ago, I made a preliminary report on the use of epinephrin in progressive myopia. It was then my belief that its use, aided by an effort to increase the secretion of the suprarenals through urging strenuous exercise, tended to check the progress of this condition. With an added experience I feel more than ever that epinephrin exerts a favorable influence on myopia of the progressive type.

Since I made that report, Incze¹ has published a paper in which he states that myopia is not a disease per se but is a manifestation of a universal congenital asthenia. This constitutional peculiarity of the sclera, the weakness of an asthenic mesenchymal derivative, especially affecting the elastic elements of the sclera, permits the stretching of the globe and thus the myopic change of refraction. He considers that in this scleral stretching another phenomenon of asthenia plays its part, namely, deficiency of epinephrin in the organism, in addition to an altered condition of the endocrine function in general. He considers that age and occupation play no part. In his series of 188 cases of myopia, the ages varied from 10 to 65 years, and there were just as many patients among those who performed labor not requiring close use of the eyes as otherwise. He also lays stress on bodily habitus in the development of myopia.

It might be well, at this time, to comment on the recent work of Levinsohn², which seems to have been confirmed by the work of Essed and Soewarno³. Monkeys were kept in a horizontal posture for five hours each day with the eyes directed toward their feet. Myopia developed rapidly and in a high degree.

Might not the cramped condition of the body and the curtailment of exercise have had some influence on the lowered secretion of the suprarenals? Levinsohn points out that watchmakers are not subject to myopia, whereas type-setters are. He ascribes this to a difference in the head and body posture, which also might influence the action of the suprarenals.

From my series I have selected 159 cases of myopia. Only ninety-nine of these are included in this report. No case was considered that did not show evidence, from either observation or a clear history, of a definite increase in the myopia before treatment was started. Sixty patients were rejected, for the most part on account of not having been observed a sufficient length of time; of not reporting for observation; of a history of epinephrin not having been used, or of otherwise not showing sufficient proof. I have considered a case as checked in which the myopia has not increased on an average more than 0.25 diopter over a period of one year. According to this classification, seventy-nine cases were checked and twenty cases progressed. It has been suggested that I have no control cases of progressive myopia which have been observed without any treatment. This I did not consider advisable for two reasons: First, having confidence in the efficacy of the treatment, I wished to give every patient the benefit of its use. Second, it seemed to me that, since only cases of proved activity were included in the series, the absence of increase in the myopic refraction over a period of a year or more was sufficient proof, without a control series. This, however, can be done in a

future report, in which I hope to present a still greater number of cases observed over a longer period of time.

The table presented when this paper was read before the Section on Ophthalmology of the American Medical Association shows the age of the patient, the date and the amount of refraction at the time of the first observation, the date when epinephrin was first started, and the date and amount of refraction at the last observation. Some of the cases showed little or no progress during the whole time they were observed. A few showed a slight improvement and several showed an increase in visual acuity, even though the refraction did not change. Even in the cases that have progressed unfavorably the condition seems to have increased less than before the use of epinephrin.

Contrary to the observation of Incze, the majority of my patients have been inclined to be well nourished and well developed, rather than of the thin and angular type such as he described as "asthenic". It was the exception to find, however, two patients showing an increase in myopia who were of a definite athletic build. The usual difficulty has been to get patients to exercise, and especially to take strenuous exercise. Another difficulty encountered has been to impress on them the importance of continuing the treatment indefinitely until told to stop. It has not been at all unusual for the patient to return in six months or a year with the information that he had finished one bottle of the medicine and thought that that was enough. These cases were, of course, not included, and wherever the epinephrin was not continued for at least a year the case was not included in this report.

A few typical examples may serve to illustrate the seeming influence of the epinephrin:

M. V., a girl aged twelve years, observed for the first time in 1923, showed normal vision and refraction. Two years later she developed a myopia of 0.75 diopter in the right eye and of 1.00 diopter in the left. She was immediately placed on the treatment outlined and

has been most faithful in carrying out instructions. She has been followed over a period of four years, and there has been no increase in the right eye, and only a 0.25 diopter increase in the left.

L. M., a boy aged fourteen years, first observed March 7, 1925, was wearing -5.00 sphere for each eye which had been given him twelve months before. He required -5.50 sphere -0.75 cylinder axis 30 degrees for the right eye and -5.75 sphere -0.50 cylinder axis 160 degrees for the left to bring his vision to normal. He has been watched over a period of more than four years, during which time there has been no increase at all in the right eye and only a 0.25 diopter increase in the left.

On the other hand, his brother has shown an increase of 2.0 diopters in each eye. Both have carried out the treatment faithfully.

Case 5 is interesting in that the patient was hyperopic in 1926 and showed a tendency to myopia in the left eye with reduced manifest hyperopia in the right eye in 1927 and 1928, whereas in 1929 the refraction was normal again in the left eye, with the original amount of hyperopia in the right.

The case of U. R., a girl aged sixteen years, is worthy of note in that the patient showed a rapid change from a manifest hyperopia of 0.5 diopter, April 7, 1923, to 1.00 diopter of myopia on November 20th, six months later. She was immediately placed under treatment, and, as she showed no change for nearly two years, the drops were reduced to twice daily and then to once daily. March 17, 1925, she showed a sudden increase to -1.50 sphere -0.50 cylinder axis 180 degrees in each eye. The original dosage was immediately restored. There has been an increase of less than 0.75 diopter in the right eye and of less than 0.5 diopter in the left eye in the four succeeding years.

Mrs. H. G., aged thirty-two years, had always been farsighted previous to January, 1925. She came for examination, July 13, 1926, wearing -0.37 sphere for each eye, but required con-

siderably more than this to bring her vision to normal. Her vision increased immediately after she began using epinephrin, and, as she is an intelligent woman, she uses her own judgment as to the use of epinephrin. Whenever she notices that her distant vision is failing, she immediately resorts to the drops and she then sees better within a very short while.

R. K., aged nine years, showed an increase of 1.5 diopters in three years, and the vision could not be brought to normal even with this correction. The vision improved immediately with the use of epinephrin. Seven years later there had been an increase of only 1.00 diopter, with normal vision in each eye.

K. D. J., aged eighteen years, gave a history of having been hyperopic for eight years previous to December, 1928, when he suddenly developed myopia. He had been a hard working student at the University of Illinois. The epinephrin treatment was started January 19, 1929. His studying was not curtailed in the least, except that he was told that it must not interfere with his getting plenty of exercise. January 24, 1930, there had been no change in the error of refraction.

S. J. M., aged seven years, was hard to manage, but the myopia showed a definite tendency to increase each time the patient slackened in the use of the drops. It has remained stationary for the last two years, during which time she has been faithful in carrying out instructions.

M. H., aged eight years, was first seen October 6, 1923. Vision of either eye with -0.75 sphere -0.37 cylinder axis 90 degrees was 15/12. He was re-examined August 28, 1924, October 24,

1925, October 16, 1926, August 28, 1927, and November 14, 1929, with no change in vision or refraction. The family of this patient all have high amounts of myopia of the progressive type.

Four cases of corneal involvement, three of which were included in the first report, are included in the ninety-nine cases.

Comment and conclusion

From the observation of these cases, it seems that age is a factor in the development or progress of myopia. With few exceptions, the patients were all of school age.

All of the patients whose cases are recorded* were seen in private practice, and the vast majority were well nourished and well developed. I believe that these patients have shown a tendency toward overweight and overgrowth rather than otherwise, especially noticed in the cases that progressed unfavorably. Two of the latter were of definite athletic and muscular build, which is most unusual. In general, I am certain that they were not more studious than the average. The majority seemed averse to taking strenuous exercise and tended more toward showing easy-going, inactive, or sluggish characteristics. I believe that there is a certain type of progressive myopia which is favorably influenced by exercise and local instillation of epinephrin. On the other hand, another type definitely suggests some other factor the nature of which is not yet clear.

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* A detailed report of ninety-nine cases will be found in the transactions of the Section on Ophthalmology of the American Medical Association for 1930.

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ETIOLOGY AND CHEMICAL NATURE OF CATARACTOUS LENSES

A review

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The author presents a careful review of the recent literature of this subject. From the Department of Ophthalmology, State University of Iowa, Iowa City.

In general, the conditions that cause cataract may be accidental or inherent, they may reside in the outside world and exert a mechanical or physical effect, or they may be associated with certain metabolic changes.

In the first group of causative agents light and heat are the most important. The term "glassblower's cataract" designates a type which has been well known since the investigations of cataracts by Robinson¹ among bottle finishers and bottlemakers. The name is self-explanatory in that it suggests the fact that glassblowers frequently develop cataract, which in its appearance is of a special type and has nothing to do with hereditary or other known pathologic factors (Roberts)². According to Healy³, "two types of opacities predominate, one being the dense, round, posterior cortical and the other a striated, cortical, wedge-shaped opacity, apex upwards, growing in the lower cortex or downwards and slightly inwards." In a sense it may be classed with senile cataract.

Stoewer⁴, who examined 591 workers in the glass industries, found no indications of cataract formation previous to the twentieth year of life. Between the ages of twenty and thirty years only slight opacities were observed. Typical cataracts occurred only between the ages of sixty and eighty years. Healy examined 209 cases of cataract among tinplate millmen whose work is heavy and is carried out at high temperatures. He states that a man does not develop lenticular opacities before he has been at this work for fifteen years. Roberts² collected notes on twenty-five cases of cataract in men and women engaged in chainmaking, all of whom presented in one eye or both a poste-

rior polar and cortical opacity of a type closely resembling that occurring in glassblowers. "It differs from congenital cataract", he says, "on account of its physical appearance and its onset in middle life, between the ages of forty and forty-five." In all cases in which fundi could be seen there was nothing abnormal noted.

As regards the occurrence of this type of cataract (in England), Legge⁵ produced figures showing that three percent of (1) superannuated, disabled members and (2) of the members placed on reduced sick allowance are affected with cataract or probable cataract at the average age of fifty-six years. According to Norris and Oliver⁶ the percentage at various clinics for all eyes is between five and ten. "The cases among 'puddlers' (iron smelters) are comparatively few, perhaps only one or two are seen each year. However, 'puddlers' are few in number" (Cridland⁷).

In an attempt to explain the precise action of light in bringing about opacities of the lens, Crookes⁸ examined the radiations from molten glass in the glassblower's furnace and found them to be rich in red and infrared rays. Hence he concluded that the long waves of the spectrum are responsible for glassblower's cataract. Burge⁹, however, failed to produce any changes in pig lenses by exposing them for two hours to the light of an electric furnace at 1,000°C. During the experiment the lenses were kept submerged in 0.1 percent solutions of the following substances: calcium chloride, magnesium chloride, sodium silicate, and dextrose. Care was also taken to exclude all heat effect. On the other hand, Burge did produce coagulation of the lens protein by ultraviolet rays

under similar conditions, lenses in the calcium chloride solution being acted upon especially in the cortical part, those in potassium chloride solution being affected in the nucleus.

According to the most recent investigations by Schl  pfer¹⁰ on enucleated animal eyes, the minimum light absorption by the aqueous, the lens, and the vitreous lies between the wave lengths of 750 to 850 $\mu\mu$. The lens is peculiar in that its absorptive powers are much greater than those of water for wave lengths of 700 to 1,300 $\mu\mu$, but less than those of water for wave lengths of 1,300 to 1,600 $\mu\mu$. Otherwise the three media show greater absorptive powers than water for all wave lengths.

The amount of light waves absorbed by a medium is directly proportional to the thickness of the medium. Of the three media, in thicknesses as they exist in the human eye, vitreous absorbs the largest amount and aqueous the smallest amount of infrared rays. On the basis of a unit thickness, the lens is most efficient in absorption between wave lengths of 700 $\mu\mu$ and 1,250 $\mu\mu$, the aqueous least efficient between 700 $\mu\mu$ and 1,100 $\mu\mu$. Between wave lengths of 1,200 $\mu\mu$ and 2,000 $\mu\mu$ all three media absorb approximately to the same extent. Hence the lens absorbs largely infrared rays and is chiefly injured by these wave lengths. Vogt¹¹ and Berner¹² report similar results. They also state that the lenses of older animals undergo opacification more readily than those of younger animals.

Furthermore, Hartridge and Hill¹³ have shown that the iris absorbs practically all the infrared rays between 5,000 $\mu\mu$ and 13,000 $\mu\mu$ and that radiations of greater wave lengths are absorbed by the cornea and aqueous. The lens absorbs ten to thirty percent of the red rays between 11,000 $\mu\mu$ and 13,000 $\mu\mu$. The experiments of B  cklers¹⁴ point in the same direction. He observed only a temporary impairment of the cornea and a slight exudate in the aqueous humor after a two-hour radiation with a mercury arc lamp of 500 to 285 $\mu\mu$ wave length. The lens

remained without the slightest opacity. The effect is even less if all infrared is excluded. And Healy³ points out that "in the tinplate mill the men are exposed to practically no ultraviolet rays, but they are exposed constantly to excessive amounts of infrared rays". The work of Burge has been criticized on account of the use of unequal concentrations of the two types of radiation.

Cataracts are known also to have been brought on by means of an electric shock. Brixia¹⁵ seems to have been the first to report a case of electric cataract (1897). A woman twenty-one years of age was struck by lightning while working at a telegraph instrument. Severe burns were inflicted on the nose and the left foot. Three months later her vision was found to be reduced in each eye to 0.1. A second case was brought to attention by Desbri  res and Bargy¹⁶. The patient had received a shock of 20,000 volts. Franklin and Cordes¹⁷ had the opportunity to study a cataract which had been contracted by electric burns of only 220 volts on the forehead over the left eye. Accordingly they found that the left eye had been more affected than the right one. Richter¹⁸ observed a cataract in each eye of a young man who had been struck by lightning thirteen years before and had noticed his deterioration of vision soon afterwards.

Holloway¹⁹ reports the case of a fourteen year old boy who at the age of twelve years received an electric shock of 2,200 volts. Failure of vision was first noted nineteen months after the injury. At the time of examination by Holloway, the lens was completely cataractous and of the soft variety. There was a small irregular capsular plaque involving the lens, slightly down in the right eye, and central in the left. There are many more electric cataracts on record but these instances suffice to show their occurrence.

The typical lenticular changes observed in such cases are described by Franklin and Cordes as consisting of

"fine, greyish dots in the cortex with subepithelial opacities, appearing more or less flaky in most instances." Ulrich²⁰ believed that these opacities were due to albuminous coagulation. But Robinson points out that if this were true they would appear promptly. According to Hess²¹ the microscopic changes consist of an extensive alteration of the anterior capsular epithelium. "Sometimes", he states, "a considerable mass of dead epithelium is separated from the capsule by a flaky albuminous substance." Also Kiribuchi²² showed experimentally that the electric current can cause a subepithelial albuminous coagulation.

Speaking of the second group of etiologic factors involved in cataract formation, that is, factors which are more or less inherent in one's bodily make-up, one naturally thinks first of the so-called congenital cataract. Such a case is reported by Braun²³. He observed crystals in the clear lens of an otherwise normal nineteen-year-old male. The crystals were more highly refractile than those of cholesterol. On closer examination with the slit-lamp and corneal microscope they appeared like concretions of calcium phosphate. Later the patient's mother, fifty years old, came for treatment for ulcer serpens of the left eye. In the lens of the afflicted eye crystals were found of the same appearance as those observed in the lens of her son. Braun concluded that these two cases presented congenital cataracts with crystal formation. The lens of the latter patient was extracted and the crystals were examined. They yielded no phosphoric acid. Their exact nature could not be ascertained, except that they contained calcium carbonate as well as other unknown constituents.

Pellaton²⁴ examined the eyes of eighty-two school children of whom fourteen were boys and sixty-eight were girls with an age variation from nine to sixteen years; 141 eyes (85.97 percent) possessed normal vision. The remainder showed an impaired vision. However, in 96.3 percent of all the eyes examined various opacities were found.

Only three children (3.7 percent) had perfectly clear lenses.

Discussing hereditary cataract, Rowen and Wilson²⁵ state that in all cases the cataract comes on between the ages of thirteen and eighteen years. Previous to this time the vision is good. In the early stages the cases present opaque radial spokes like ordinary senile cataract. Both eyes are usually affected.

In the search for the underlying physiologic causes of cataract formation, especially of the hereditary type, certain disorders of the endocrine system, particularly of the thyroid and parathyroid glands, have been suggested. Greppin²⁶, in collecting literature over forty-one years on tetany due to parathyroid deficiencies, found that 50 percent of the cases were associated with cataract. Moreover, Peters²⁷, Fischer and Triebenstein²⁸, and Hesse and Phelps²⁹ submit evidence for the presence of a latent tetany in about 88.0 percent of senile cataract cases. The experiments on animals by Erdheim³⁰, Possek³¹, Schiøtz³², and Hiroishi³³ also suggest tetany as a possible cause of cataract. Likewise Luckhardt and Blumenstock³⁴, while conducting researches on old thyro-parathyroidectomized dogs, observed bilateral cataracts. Assuming tetany as being responsible for this pathologic eye condition, Eiseman and Luckhardt³⁵ produced a series of tetany symptoms in normal dogs by intravenous injections of oil of wormwood and subcutaneous injections of strychnine sulphate; no cataract was produced in the two dogs that survived the treatment for three months. The results were also negative in dogs whose blood calcium was kept below normal for six days as well as in those whose blood was charged with excess of calcium for seven months.

Parallel with the above, Pelláthy and Pelláthy³⁶ found the range of the blood calcium of forty-eight senile cataract patients to be 9.1 to 11.9 mg. per 100 gm., which closely agrees with that of individuals of the same age free from cataract. Adams³⁷, however, who

examined the blood of twenty-one normal subjects and twenty cataract patients, obtained 9.76 mg. per 100 gm. calcium for the first group and 11.46 mg. per 100 gm. for the second group. Reeder³⁷, reporting his own observations of a bilateral cataract following thyroidectomy in a forty-year-old housewife, calls attention to thirty-seven similar cases reported by other clinicians.

Kerr, Hasford, and Shepardson³⁸, by administering Armour's desiccated thyroid substance to twenty-eight patients with senile cataract, observed improvement in 35.6 percent of the cases within four to six weeks; 35.6 percent showed no change; 28.2 percent had grown worse. Whether the improvement resulted from regeneration of the lens tissue or from dissolution of the opacities is not stated, and evidently is not known. However, regeneration might be possible in view of the fact that "the lens cells grow and multiply from the time of birth of the individual until his death, be he ever so old, unless the lens become cataractous, when they cease to grow and the lens becomes a dead inert mass in the living eye" (Davis)³⁹.

Additional support for the importance of thyroid secretion in the metabolism of the lens is furnished by the experiments of Lenhard⁴⁰. He removed the thyroid glands from a number of young salamanders (*triton cristatus*), after which the lenses were extracted at various intervals over a period of three to twenty-six days following the operation. Observations of the regenerating eyes were made beginning with the twelfth day and ending with the fiftieth day after the lens extraction.

The development of the secondary eyes is briefly as follows: A cleft forms between the two pigment-containing parts of the epithelial layers around the pupil. As the epithelial cells multiply the pigment disappears. Within two weeks the lens bud has been laid down and at the end of the third week this bud has developed into a vesicle. The cells of the posterior wall of this

blisterlike structure stretch in a characteristic manner towards the lumen, differentiating themselves into lens fibers and rapidly filling the hollow of the vesicle. The cells of the anterior wall form the epithelium. At the end of the first month the cell nuclei of the interior of the lens have disappeared and a normal miniature lens has developed. Thus the main difference between the secondary lenses of the thyroidectomized and normal animals seemed to be their size. For control, sixty-six normal eyes of similar animals were examined at various stages of their development. In a number of cases, however, no difference was observed between the lenses of the two groups of animals.

It is apparent therefore that tetany and disturbances in the thyroparathyroid function are not physiologically coextensive with cataract formation, and likewise that some types of cataract are etiologically to be connected rather with the immediate influences of the gland itself as a whole than with certain characteristic symptomatic conditions of its disorders; i.e., tetany. In other words, tetany might accompany only a particular phase of parathyroid dysfunction. If this be true, tetany is only accidentally connected with cataract formation by coincidence with some other condition, which is the true cause.

In view of the important rôle that vitamins play in physiologic processes, some authors have suggested avitaminosis as one of the possible causes of cataracts. In order to throw light on this matter, Stepp and Friedenwald⁴¹ kept (1) mother rats with their litters immediately after the birth, and (2) one mother rat six days before the birth, on a diet rich in calcium, but deficient in phosphates, in the antixerophthalmic vitamin A, and in the antirachitic vitamin D. None of the rats showed opacities of the lens at the end of the eight or more weeks during which time they were kept alive, although all of them had contracted a pronounced xerophthalmia.

The type of cataract ordinarily

found in senile persons is especially characterized by the insidiousness and slowness of its formation and by the fact that it occurs in advanced age. It is the usual cataract and the one most frequently met with in ophthalmic practice. Hence its etiologic factors are assumed to be more varied and to be scattered over a much greater range of physiologic conditions than is the case with any other type of cataract. It is thus characterized by Kerr, Hasford, and Shepardson³⁸: "Senile cataracts represent the local changes in the lens of individuals who are the subjects of general degenerative disturbances. This is strongly suggested by their appearance late in life, their bilateral occurrence, and the tendency to vary with the general health of the patient." Burdon-Cooper⁴² likewise thinks that the factors responsible for this type of cataract are more intimately connected with the general metabolism than with any local disturbance, and that the condition is chiefly characterized by a decomposition of the lens protein.

Harkness⁴³ contributes the following picture of the general etiology of the senile cataract: "The cortical changes are first not so much in the lens fibers themselves as in the interfibrillar spaces. Actual fissures occur which are filled with fluid. Later the changes take place in the lens fibers. Cataracts may progress rapidly to a certain point, then apparently be retarded, or even enter a stationary period, and finally undergo reabsorption. Complete spontaneous clearing after the formation of opacities is reported in 147 cases by fifty-one observers (American Encyclopedia of Ophthalmology, p. 1503)."

Löwenstein⁴⁴, on the other hand, stresses injuries of the lens membrane, such as are frequently seen among glassblowers, in his explanation of cataract formation. He had a case under treatment where the lens capsule of both eyes showed distinct ruptures. The left eye presented an already mature cataract. "A frog-muscle preparation with its surrounding membrane intact", Löwenstein points out, "can be

kept in Ringer's solution for a considerable length of time without change in weight. As soon, however, as the membrane is ruptured the muscle swells." By analogy he thinks that similar conditions must prevail also in the lens. This opinion he further substantiates by experimental evidences that no damage is done to the lens by a possible presence of enzymes in the ocular humors.

It is now general knowledge among oculists that of all the patients of the usual hospital type, diabetics furnish the largest percent of senile cataracts. Even in children cataracts have been observed accompanying diabetes. Thus Sherrill⁴⁵ reports bilateral cataract formation in a diabetic boy fifteen years of age. Joslin⁴⁶ made a similar observation on a twelve-year-old diabetic girl. Records of two other cases have been published by Strouse and Gradle⁴⁷, and Major and Curran⁴⁸.

The most extensive and systematic study that has ever been made of the relationship between cataracts and sugar tolerance was carried out by O'Brien⁴⁹ on seventy-two unselected cataract cases whose ages varied between thirty-seven and eighty-seven years with an average age of 65.6 years; 53 percent of the cases showed a maximum arterial blood-sugar concentration of over 0.24 percent after the ingestion of 100 gm. of glucose; 73 percent had a sugar concentration of over 0.22 percent. In twenty-two percent the sugar level failed to return to normal within three hours. In eighty percent it failed to return to normal after two hours; twenty-eight percent of the patients showed distinct signs of diabetes. Coincidentally-taken blood analyses for lipids showed that cholesterol, which was determined on eighty-one patients, exceeded the normal value of 0.14 to 0.17 percent in fifty percent of the cases, reaching 0.2 percent on fifteen occasions. Lecithin values centered closely around the upper normal figure of 0.3 percent.

An explanation of the rather high blood-cholesterol values is suggested by the experiments of Michail and Van-

cea⁵⁰, who produced hypercholesterolemia in rabbits by feeding them naphthalene. These investigators believe that this increase in cholesterol was a consequence of a defense reaction which the body developed against the naphthalene poisoning. It is possible that certain toxins, as naphthalene and the metabolic products of diabetic ketosis, may be responsible for both the formation of senile cataract and the increase in blood cholesterol. In fact, it is this frequent occurrence of cataract among diabetics and persons subject to some other more or less chronic metabolic disorders that suggested to Römer⁵¹ the idea of searching for the etiology of senile cataract in certain toxic substances of the blood coming from a faulty metabolism. He demonstrated in diabetics the presence of special lens antibodies after injecting diabetic serum intraperitoneally into guinea-pigs. The publication of his researches gave rise to the immunological explanation of cataract formation.

Römer assumed on the basis of his findings and Uhlenhuth's⁵² immunological experiments with lens protein that the cells of the lens possessed receptors in the sense of Ehrlich. These receptors must be capable of uniting with specific substances for which they have a specific affinity, thereby obtaining their nutrition. Certain toxic substances from the blood serum find their way into the lens and interfere with its nutrition, thus bringing on cataract.

Römer's publication of his observations soon attracted the attention of several investigators. However, if his work had not been coupled with that of Uhlenhuth, namely the discovery of the organ specificity of the lens protein, it would have probably never aroused this interest in the immunological reaction of the lens substance. "The lens of different species", in the words of Hektoen⁵³, "gives the same immune reaction. A lens antiserum, produced (let us say) by injecting a rabbit or guinea-pig with beef lens, will react in precipitation, anaphylaxis, and complement-fixation tests not only with

beef lens, but also with the lens of other mammals, of birds, and amphibians. The specificity of the reaction is determined not by species as in the immune reactions of blood, serum proteins, and bacteria but by the organ from which the antigen is derived." Hence in regard to the immunological reactions of the lens we must speak of an organ specificity. "A lens antiserum", again quoting Hektoen, "reacts with the lens of the species, even of the very animal that furnishes the serum, but not with any other protein, and antisera produced by injecting animals with blood or serum do not react with lens solutions."

An interesting as well as a significant phase was added to the discoveries of Römer and Uhlenhuth by the work of Guyer and Smith⁵⁴. They sensitized the serum of fowls with the lens of rabbits and injected this sensitized serum at regular intervals into other pregnant rabbits. It was found that some of the newborn rabbits showed opacities and other abnormalities of the lens, mostly bilateral, but sometimes only unilateral, whereas the lenses of the mother rabbits had suffered no change. When the sensitized serum was injected into male rabbits, their lenses likewise showed no changes. The lens fibers seem to be exclusively acted upon by the antibodies. On the supposition that all the animals of a litter or even a majority might not be acted upon, or a given individual might be affected only in one eye, Ellis⁵⁵, in his discussion of Guyer and Smith's work, expresses the opinion that the placenta might be impervious to such antibodies, and that the injury of the eye must be a consequence of a direct mingling of fetal and maternal bloods due to an occasional rupture of a placental blood vessel. Once the defects had been established in the eyes of their experimental rabbits, Guyer and Smith carried them through to the sixth generation by breeding. They also observed that without subsequent treatment, the cataracts in each successive generation became increasingly pronounced. These authors are of the

opinion that the absorption of the antibodies is possible because of the presence of blood vessels around the embryonic lens.

In agreement with Römer's⁵¹ theories regarding the mechanism by which the lens secures its nutrition, but in seeming opposition to the findings of Guyer and Smith that no changes occurred in the normal lens when sensitized serum was injected into rabbits, Davis⁴⁹ reports a certain lytic action between lens antibodies and the cataract lens. If the toxic substances coming from faulty metabolism, reasoned Davis, are responsible for cataract, then any lens antigen injected into the body will neutralize these toxins and also stimulate the production of such specific antibodies as will act selectively on the decomposed, opaque lens fibers (i.e., cataract) and cause their liquefaction and absorption. With this idea in mind he undertook on cataract patients a treatment consisting of a series of lens-antigen injections. The results which he obtained are as follows:

Patients	72	
Cataracts	131	
Improved	86	} 93.12%
Arrested	36	
Worse	9	

In the course of the treatment Davis realized the importance of the rôle which the leukocytes and the lymphocytes play in the regeneration of disintegrated tissue and in supplying the needed nutriment to the restored parts. According to Carrel⁵⁶, "the lymphocytes remain through life as a store of embryonic growth-promoting substances or trephones, which may cause a resumption of cell activity when it is needed. They are evidently endowed with a double function, destroying foreign substances and necrotic material and promoting cell proliferation." "Therefore when the antigen is given", suggests Davis, "the eyeball should be massaged or some irritable fluid injected subconjunctivally." In fact, a number of ophthalmic surgeons claim to have arrested or even obliterated in-

cipient cataracts by the use of local irritants alone, such as glycerine, dionin, or calcic-alkaline-iodide ointment. Thus local hyperemia is excited, which supplies to the eye not only leukocytes and lymphocytes, but also growth-promoting hormones and alexin for a possible complement fixation in case lens antigen is used at the time. Ordinarily the aqueous humor contains no alexin (Zinsser⁵⁷).

Ellis⁵⁵ repeated the lens antigen treatment on twenty-seven cataract cases according to the directions of Davis. These twenty-seven cases comprised the following types of cataract: traumatic, two; cortical, fifteen; sclerosed, five; diabetic, four; and complicating glaucoma, one. In no case was absorption of cataract observed. On the contrary, in fourteen cases the cataract continued to progress as before; thirteen cases showed no progress. Except in one case of anaphylactic shock the treatment produced a general tonic effect in all patients. However, Ellis warns against indiscriminate use of this treatment. "If the work of Guyer and Smith", he reasons, "is correct, then one should rather expect no effect on the lens of the patient, but rather, if it were a female, that her children would be born into this world with varying types of eye defects, and lenses in different stages of opacification and absorption."

Evidently the work of Guyer and Smith has revealed solid facts, for similar results had been obtained some eight or ten years before by Pagenstecher⁵⁸ by feeding naphthalene to pregnant rabbits and guinea-pigs. Opacities of the lens were observed in the offspring of both species to the extent of seventy percent for the rabbits and thirty-three percent for the guinea-pigs.

Furthermore, the results of Pagenstecher's naphthalene treatment have recently been duplicated by Kusagawa⁵⁹ in his work with chickens. The naphthalene was administered either by mouth as an admixture with food or by a subcutaneous injection of its aqueous emulsion or in solution in

alcohol, ether, benzine, or olive oil. But, contrary to the results obtained by Pagenstecher by a similar naphthalene administration to rabbits (that is, contrary to the fact that the effects of the above treatments of the mammals appeared only in the offsprings of the treated female animals), the chickens showed more or less lens opacity even on the fourth day of the treatment. However, the naphthalene doses were more effective in the production of lens opacities and other eye anomalies when they were injected into the eggs during the early stages of incubation (between the third and the seventh day). When hens that had acquired lens opacities through either of the treatments were mated with normal cocks they frequently produced chicks with congenital cataracts and other eye defects.

Control injections consisted of water, air, sodium chloride solution, glucose solution, and the solvents used in the preparation of the naphthalene solutions. Next to naphthalene, alcohol was found to be most effective in causing eye defects. Water, air, sodium chloride, and glucose never produced any kind of disorder. Glucose injections into the eggs, on the contrary, even proved to be growth-promoting to the chick embryo. But, according to

ous investigations have been carried out of late as regards the chemical composition of both cataractous and normal lenses, particularly with respect to their lipid content. Graefe⁶² was probably the first to publish a report of his discovery of the presence of cholesterol in the lens of both eyes of a seventy-three-year-old female patient. The crystals could be seen with the unaided eye. The lens nucleus was perfectly clear. The cortical substance between the crystals was likewise more or less free from opacities. There were indications of liquefaction in the lens of the left eye. The right eye presented a mature cataract.

Later Mettenheimer⁶³ discovered doubly refractile substances in cataractous lenses which could not be found in normal lenses. He regarded them as myelin. In one particular case, where the lens presented a rather clear appearance, he also succeeded in isolating cholesterol in addition to myelin, by boiling with alcohol.

Some twenty-seven years after the publication of Graefe's report the first systematic study of the chemical composition of both normal and cataractous lenses was carried out by Cahn⁶⁴. For lipids he submits the following figures (evidently computed on the basis of the dry lens material):

Determinations	Normal lenses	Cataractous lenses
Cholesterol	0.62%	4.55 to 6.22%
Lecithin	0.63%	0.80 to 4.52%
Fat	0.79%	1.19%
Alcohol extracts	0.71%	0.83 to 1.45%

Bender⁶⁰, when sodium chloride was injected directly into the lenses of rabbits by the method of Solenkowsky⁶¹, cataracts were produced, the extent of which varied directly with the concentration of the sodium chloride solution. Rabbits which had previously received intraperitoneal injections of lens protein responded much more markedly.

Thus far we have dealt largely with the physical characteristics of the lens, both in its normal and cataractous states. Especial attention has been paid to various factors involved in the etiology of senile cataracts. Numer-

Since then numerous investigators have confirmed Cahn's findings. Lang⁶⁵, Krautschneider⁶⁶, Toufesco⁶⁷, Leber⁶⁸, Gross⁶⁹, Hoffmann⁷⁰, Adam⁷¹, Vogt⁷², Wessely⁷³, and Busacca⁷⁴ have observed crystalline masses in the lenses of some of their patients. In their physical properties, as revealed by the slit-lamp or the polarization microscope, the crystals in most cases resembled those of cholesterol or myelin. In some cases when the lens was removed and the crystals were subjected to a more minute examination, they invariably responded to tests for

lipids, especially cholesterol. In a few cases the crystals were found scattered here and there in an otherwise clear lens, but more frequently they occurred in association with opacities and especially with mature cataracts.

The most recent, extensive and thorough microscopic examination of cataractous lenses has been carried out by Kranz⁷⁴ using the polarization microscope. Myelinlike, doubly refractile substances and occasionally cholesterol crystals were found only in senile cataracts and in traumatic cataracts caused by some gross physical injury. They were not present in traumatic cataracts caused by perforation; neither were they present in swollen lamellar cataracts nor in clear normal lenses. Salit⁷⁵ studied the lipid partition in the lenses of senile human cataracts. His findings are summarized in table 2.

Table 2

Lipid fraction	Cholesterol	Lecithin	Saponifiable fat
Average %	0.61	0.99	2.80
Range %	0.23 to 0.89	0.48 to 1.88	1.53 to 4.00

Besides an increase in lipids, cataractous lenses differ from normal lenses in that the former show much larger amounts of inorganic constituents. Cahn⁶⁴ found the following relationships on the basis of the dry lens substance:

Constituents	Normal lenses	Cataractous lenses
Soluble salts	1.36%	1.81 to 2.41%
Insoluble salts	0.46%	1.14 to 1.45%

Burge⁷⁶, who analyzed the ash of both normal and cataractous lenses, submits these results:

	% calcium	% sodium	% silicon
Normal adult human lens	?	?	0.00
Normal adult pig's lens	0.08	6.67	0.00
Human embryo lens	?	?	0.00
Human cataractous lens	12.50	23.82	0.00
Human cataractous lens (India)	6.00	25.06	0.00

Calcium depositions have been observed in both clear and opaque lenses after the fiftieth year (Kranz⁷⁵). Adams⁷⁷ found the following average calcium values for normal and cataractous lenses: normal, 18.5 mg. per 100 gm.; cataractous, 65.3 mg. per 100

gm. Salit⁷⁶, however, using a single lens in each determination, failed to demonstrate the presence of calcium in both normal animal lenses and in a few human lenses with incipient cataract. One black cataract, the only one examined, likewise contained no calcium. The average calcium values of mature human cataracts was found by Salit to be 35.4 mg. per 100 gm. The values varied from 2.8 to 108 mg. per 100 gm.

Differences have been noted in the protein content also. The protein values of senile cataractous lenses were found by Salit⁷⁹ to vary from 13.19 to 36.63 percent, depending on the degree of maturity of the cataract. The protein values for normal human lenses are given by Jess⁸⁰ as thirty-two percent in youth, and thirty-eight percent in old age. Jess⁸⁰ also states that the

absolute total protein and water content of senile cataractous lenses decreases constantly with age. The rate of reduction of the water content however exceeds that of the protein. Michel and Wagner⁸¹ showed that the nucleus of mature senile cataracts pos-

sessed no protein, while in the cortex traces of globulin were still found. Other forms of cataract, as the trau-

matic and the immature senile types, contained protein in normal proportions.

The relative amounts of different kinds of the protein present in the fresh normal lens are given by Mörner⁸² in the following classification:

- (1) Water-insoluble albumoid—17% of lens mass, 48% of total protein (identified as euglobulin by Woods and Burky⁹¹).
- (2) Water-soluble protein—18% of lens mass, 52% of total protein.
 - (a) Alpha crystalline—6.8% of lens mass, 19.5% of total protein, 37.0% of soluble protein (identified as pseudoglobulin by Woods and Burky⁹¹).
 - (b) Beta crystalline—11.0% of lens mass, 32.0% of total protein, 63% of soluble protein.
 - (c) Albumin—0.2% of lens mass (named gamma crystalline by Woods and Burky⁹¹).

According to Jess⁸⁰, the decrease of protein in mature cataract lenses is represented solely by the loss of the crystalline form. Albumoids in the majority of cases were found to have increased.

In a further study of lens proteins, Reiss⁸³ found that the normal lens gave an intense nitroprusside reaction, showing that it contained cystein in relatively large amounts. In the mature senile cataract this reaction was negative. In the nonmature forms the intensity of the reaction varied according to the extent of the cataract formation. Cohen, Kamner, and Killian⁸⁴ likewise report having obtained a pronounced nitroprusside color reaction in their experiments with normal lenses both human and animal; whereas of sixty-four cataractous lenses, twenty-six (40 percent) showed no color, nineteen presented a trace of color about the periphery, and in nineteen a color definitely lighter than that seen in the normal lens was found. The fact that the cortical part is the last to lose its nitroprusside color reaction seems, on the one hand, to contradict the contention of Jess⁸⁰ that the crystalline-containing nucleus is especially rich in cystein, and, on the other hand, it seems to corroborate his statement that it is chiefly the nucleus that suffers changes in cataract formation.

When the lens is subjected to freezing it loses its ability to produce the nitroprusside reaction. At least this is

Jess's⁸⁰ interpretation of Chalupeky's⁸⁸ results, although Chalupeky attributes it to the action of the ultraviolet radiation which preceded the freezing. In fact, since Chalupeky's color tests necessitated the use of thin slices of the lens, freezing was employed merely as a preparatory stage for the microtome, and hence its effect on the lens might have escaped observation. Jess repeated the work of Chalupeky with ultraviolet rays, omitting freezing. He found that ultraviolet rays produced no changes in the lens that would interfere with the color test.

From the above it appears that autotoxidizable substances, such as cystein and glutathione, must be essential for the lens in carrying on its process of respiration. These substances may be the sole agents in the regulation of its gas exchange since the remoteness of the lens from blood vessels prevents hemoglobin from being the direct source of oxygen. That some process of oxidation might underlie the metabolism of the lens and that disturbances in this respect might be responsible, at least in part, for cataract formation, is evidenced by the researches of Mashimo⁸⁶. Using the method of Wintersteiner, he found that the normal rabbit lens, when kept submerged in Ringer's solution at a temperature of 30° C., absorbed 60 c.mm. of oxygen per hour, whereas cataractous lenses took up 3 to 25 c.mm. More oxygen was absorbed by the normal lenses if their membranes were ruptured. Schmerl⁸⁷, who used Warburg's method, obtained less striking results with rabbit lenses, recording an oxygen absorption of only 4 c.mm. per hour at 37.7°C., or 7 to 8 c.mm. with the membrane ruptured. Nevertheless the results are sufficiently conclusive to corroborate Mashimo's work in its principle.

Schmerl⁸⁷ further found that if naphthalene was fed to the rabbits and five hours later the lenses were examined for oxygen, they had taken up 7 to 20 c.mm. per hour. No difference in absorption was observed whether the lens membrane was ruptured or

left intact. Two lens nuclei that were examined showed no affinity for oxygen. It is not known whether or not the hydrogen-ion concentration was the same in the two series of experiments carried out by two different methods. Abderhalden and Wertheim⁸⁸ have shown that oxidative processes of that type are very sensitive to changes in pH.

The importance of the rôle which hydrogen-ion concentration may play in metabolism of the lens is suggested by the joint work of Kirby, Estey, and Tabor⁸⁹. Using a medium containing normal concentrations of inorganic salts and having a normal hydrogen-ion concentration they were able to carry a single strain of lens epithelium of chick embryo by cultivation in vitro through unbroken generations by 112 passages over a period of seven months. At the end of this time the average increase in surface area amounted to about seven times the area of the original transplant. A hydrogen-ion concentration of 8.2 on the pH scale was found to be extremely toxic. Debilitated, sick cultures could be revived by placing them in normal media for several passages.

Discussion

Some of the changes in chemical composition that take place in the lens in its transformation into a mature cataract are: Increase in inorganic constituents (Cahn⁶⁴), especially calcium (Burge⁷⁶, Adams⁷⁷, Salit⁷⁸); increase in lipids (Cahn⁶⁴, Salit⁷⁵); decrease in protein (Cahn⁶⁴, Jess⁸⁰, Salit⁷⁹); and decrease in autooxidizable substances (Reis⁸³; Cohen, Kamner, and Kilian⁸⁴).

The fact that cataracts are usually associated with old age suggests that aging in itself must be one of the factors, probably the chief factor, involved

in the process. Dehydration of the lens protein by the increase in inorganic constituents may also play an important part. General toxemia may be stated as another factor.

In the opinion of Römer⁵¹, toxic substances act as antigens in the production of antibodies, and these in turn bring about coagulation of the lens protein. This theory finds corroboration in the results obtained by Guyer and Smith⁵⁴ in their experiments on rabbits with lens antigen. Also, the experiments with naphthalene which Pagenstecher⁵⁸ and Kusagawa⁵⁹ carried out on rabbits, guinea-pigs, and chickens lend support to Römer's explanation.

The fact that hypercholesterolemia was produced in rabbits by feeding naphthalene (Michail and Vancea⁵⁰) suggests that the abnormally high cholesterol content (or lipids in general) in cataractous lenses may be traced to similar poisons in the blood stream.

Cataracts have been frequently found associated with disorders or absence of the thyroparathyroid gland. In about eighty-eight percent of cataract cases there is a disposition to tetany (Fischer and Triebenstein²⁸). Moreover, partial cures of senile cataracts have been obtained on several occasions by administering desiccated thyroid to the patients (Kerr, Hasford, and Shepardson³⁸). It is, therefore, possible that the accumulation of calcium in cataractous lenses is the consequence of disturbances in calcium metabolism. Furthermore, tetany is a state characterized by alkalosis, and calcium tends to be precipitated in the tissue when the pH value is shifted from normal towards a greater alkalinity (Parsons⁹⁰).

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NOTES, CASES, INSTRUMENTS

ASTIGMATISM UNRECOGNIZED

EDWARD JACKSON, M.D., F.A.C.S.

DENVER

A man, aged 60, apparently in good health, came five hundred miles about his poor sight, after consulting in the last year six oculists in three states. These were all members of the American Medical Association, one of them a former chairman of the Section on Ophthalmology. The patient was much disturbed by the opinion of one of his advisers that his poor sight was due to a vascular lesion for which he should have prolonged treatment, and that the result would be doubtful. He had glasses given to him by two oculists, the last R. + 0.25 sph. + 0.37 cyl. axis 180° with a + 2.50 added for near. He brought certificates, given by a clinical pathologist, a member of the American Medical Association, that he had a negative Wassermann and negative Kahn test, and from a dental roentgenologist that he had no evidence of focal infection about the teeth. His vision with or without glasses was 0.5.

His left eye had been cut by a piece of copper thirty-three years ago. The sight was not immediately destroyed. An operation was done for an artificial pupil, but after eight months the eye was enucleated. There was a suspicion that the right eye might be affected by sympathetic amblyopia. The left eye had been the better eye, up to the time of its injury. The right had suffered from trachoma. Pannus extended 2 or 3 millimeters on the upper cornea. It had been recently under treatment, but apparently the trachoma was now not active. The palpebral conjunctiva showed cicatricial changes, but there was no marked deformity of the lids.

Examination with the ophthalmometer showed corneal astigmatism 9.00 D., + axis 7 degrees. With a + 5.00 sphere and - 8.00 cylinder axis 87° vision was 0.9. This glass was prescribed for distance; and for reading a + 8.00 cylin-

der axis 177°. With these he went home as happy as he could have been after a successful cataract operation. Cases of failure to recognize the share of ametropia in causing poor vision which is ascribed to other causes are, unfortunately, rather common, and equally so among those whose chief interest is in selling glasses.

217 Imperial building.

COAL FRAGMENT IN LENS

RAMON CASTROVIEJO, M.D.

CHICAGO

A. T., fifty-three years of age, came to the clinic April 8, 1930. History: On November 7, 1929, while working in a coal mine, was struck in the right eye with a piece of coal. He was seen by several doctors, one of whom removed something from the eye. Vision was perfect for about two weeks; when it began to fail the patient resorted to other doctors who gave a diagnosis of intraocular foreign body.

Examination: Right eye: by oblique illumination and ophthalmoscopy a complete, soft, white cataract. Central vision nil, but perception and projection; good reaction of the pupil. Tension by tonometer, 24 mm. Left eye, normal. Slit-lamp: a perforating scar in the cornea at about three o'clock, 3 mm. from the limbus. Transillumination: a hole in the iris coinciding with the perforation in the cornea; this gave the suspicion of a foreign body in the eye.

The pupil was dilated, and a rupture of the anterior capsule of the lens could be seen in direct line with the perforations of the cornea and iris; immediately behind the rupture of the capsule was a black foreign body about 1 by 1.5 mm. X-rays were taken by different methods, such as Sweet's improved method, Krückmann's, and Vogt's method eliminating the orbital walls, but in only one could the faintest

impression of a foreign body be demonstrated; it was located in the same position in repeated x-rays by the same method.

The patient was advised to have an operation for the removal of the foreign body and the lens at the same time. On April tenth, the operation was performed. The pupil was dilated with euphthalmine and cocaine ointment, 5 percent each, in four applications in an hour; anesthesia of the eyeball was effected with cocaine, 10 percent, and adrenalin 1 to 1000; parexia of the orbicularis muscle was by three injections in the temporal side by the Van Lint technique.

A suture of the superior rectus muscle was inserted; a corneal incision was made with a Graefe's knife and a conjunctival flap was included; a conjunctival suture was placed. An attempt was made to remove the lens in its capsule with Verhoeff's forceps, using a little pressure under the lower limbus of the cornea to aid in the extraction of the cataract; the lens capsule was broken and an extracapsular operation was performed. The delivery of the nucleus of the lens was accompanied by the black foreign body in an abundant quantity of cortex.

A careful toilet was made; the conjunctival suture was tied, the superior rectus muscle suture was removed, atropin ointment was used and the eyelids were sutured together.

The first inspection of the eye was made forty-eight hours later. There was a slight reaction; more atropin was applied. Daily treatments were given for five days. The conjunctival suture was then removed, and on April 28, 1930, the patient was discharged with vision of 6/15 (20/50) with a plus 10, but with the presence of some cortical masses visible with the slit-lamp, especially toward the periphery of the pupil. The foreign body was a particle of coal about 1 by 1.5 mm. in dimensions.

231 West Washington street.

EYELASHES IN POSTERIOR CHAMBER

RAMON CASTROVIEJO, M.D.
CHICAGO

C. G., ten years of age. History: Two years ago the patient was struck in the right eye with an arrow from his brother's bow; a traumatic cataract developed soon after the accident. The patient was examined by several doctors who advised the family to let the eye alone, as probably the cataract would be absorbed in time.

Examination: Right eye: perforating scar of the cornea at 12 o'clock with an anterior synechia; deformity of the pupil which is turned upward; pupils still active. On the nasal side, near the pupil, could be seen two little white points which resembled exudates; a definite diagnosis could not be made by means of ordinary clinical methods, such as the use of a powerful magnifying lens and oblique illumination.

The lens mass had been totally absorbed and the posterior capsule present appeared opaque due perhaps to the proliferation of epithelial cells from the anterior capsule. Vision was 2/200; the eye was quiet and the tension was normal. Left eye, normal.

The slit-lamp showed an adhesion of the iris to the scar on the cornea; the two white elements were found to be the bulbs of two eyelashes which disappeared through the pupil into the posterior chamber and then reappeared toward the temporal side.

The patient was advised to have the eyelashes removed. After anesthesia with cocaine 5 percent and adrenalin 1 to 1000 solution, three instillations in fifteen minutes, an incision was made with a keratome at the limbus toward the temporal side; after inserting a spatula under the eyelashes they were removed with Verhoeff's toothless forceps.

The patient was discharged two days afterward, when the eye was free from inflammation; he was advised to return to have the posterior capsule of the lens removed.

231 West Washington street.

SOCIETY PROCEEDINGS

Edited by DR. LAWRENCE T. POST

SAINT LOUIS OPHTHALMIC SOCIETY

October 24, 1930

DR. C. W. TOOKER, presiding

Present trend of thought regarding vernal conjunctivitis

DR. MAX JACOBS presented a review of the recent literature, with a discussion of the experimental work performed, especially with reference to allergic phenomena and endocrine disturbance.

Discussion. DR. M. H. POST thought that vernal conjunctivitis was not always due to the same etiological factor but was an allergic phenomenon dependent upon a number of etiological factors. He cited a case in which the patient while confined to his bed with the windows closed had no symptoms, but as soon as the windows were opened a violent attack took place suggestive of pollen-borne infection.

DR. W. H. LUEDDE spoke of having made an extensive study of vernal conjunctivitis some years ago, and stated that it was shown definitely that light was not a factor in the etiology, but that vernal conjunctivitis was a reaction to heat and dryness. The twenty-four hours of summer daylight in northern Norway with snow did not produce it at all, while heat without excessive light in dry countries produced it frequently. The deposition of lymphoid island substance about the cornea he considered a defensive mechanism similar to the reaction against heat in sunburn of the skin.

DR. MEYER WIENER stated that he was of the opinion that vernal conjunctivitis was aggravated by heat and light, and that practically all cases were more comfortable on a cloudy day when the humidity was high. Several cases had been sent to New Orleans in the summer time and had become quite comfortable, while another patient with vernal conjunctivitis found the climate

in Colorado insufferable because of the dryness.

Advisability of prescribing tinted lenses

DR. J. H. GROSS spoke of the growing tendency for opticians to give patients tinted lenses. He thought that only under exceptional circumstances was a person justified in using dark or tinted glasses, and pointed out that if ultra-violet rays were objectionable ordinary spectacle glass was opaque to these rays.

Discussion. DR. ELLIS JENNINGS thought that most of the irritations of the eye were due to errors of refraction. He saw no object in wearing tinted glasses when the eyestrain had been corrected. If patients insisted on wearing them he thought Crookes no. 1 or no. 2 least objectionable.

DR. B. Y. ALVIS called attention to the fact that, while most headaches arising from brilliant light were probably due to spasm of the iris, patients who had had their pupils dilated complained of headaches when in a strong light, and since the pupillary action was suspended the excessive light must have brought on the headaches through some other action.

Ultraviolet light therapy following plastic uveitis

DR. M. L. GREENE reported a case which clinically had resembled sympathetic ophthalmia. There had been marked plastic uveitis. After removal of the injured eye the vision of the remaining eye was 20/200. A dense scar of the cornea and a thick deposit on Descemet's membrane were left. Ultraviolet light was used on the cornea for over a year and a half and the vision improved to 20/15. Thus far no pathologic sections had been obtained.

Discussion. DR. MAX JACOBS said that he had seen the patient before he was seen by Dr. Greene, that the condition

had resembled sympathetic ophthalmia clinically, and that considering the low vision and the appearance of the eye the result was very striking.

DR. W. H. LUEDDE did not believe the condition was sympathetic ophthalmia, as there were no lesions in the fundus, but he admitted that when he had seen the case it resembled sympathetic ophthalmia clinically and the sympathizing eye had become quiet after removal of the injured eye.

DR. J. H. KELLER said that he had referred a case of sympathetic ophthalmia to Dr. Greene for ultraviolet light and that the patient had not been benefited by this therapy.

DR. M. L. GREENE,
Editor.

SAINT LOUIS OPHTHALMIC SOCIETY

November 28, 1930

DR. C. W. TOOKER presiding

Contusions of the eyeball

DR. J. F. HARDESTY reported a number of cases of contusion of the eyeball with various complications. He thought each case should be studied carefully and watched very closely, and he also warned against the indiscriminate use of atropin.

Discussion. DR. JOHN GREEN spoke of having treated a case similar to one reported by Dr. Hardesty. A young man had been struck a severe blow on the eye. Hyphema and semidilated pupil were noted. After the use of one percent atropin there was a rise in tension with severe pain. Amin-glaucozan, di-onin, pilocarpin, and eserine were all used in an attempt to control the secondary glaucoma, but without success. Finally a keratome incision was made and a large blood clot removed. Recovery with normal vision followed.

In another case a young man had been struck in the eye with a belt. A small laceration of the conjunctiva had been sutured. Forty-eight hours afterward it was found that the patient could not see. He was kept in the hospital nine days and then discharged.

When seen by Dr. Green two months later he had an extensive retinal detachment.

DR. W. H. LUEDDE called attention to the danger in using mydriatics in these contusions. He had seen a young man who had been struck in the eye with a handball four days before his first visit. He had had pain in the eye and the pupil was smaller than in the uninjured eye. A drop of euphthalmin had been used and the pain had subsided. Although there had previously been no increase in tension, when the euphthalmin was first used the tension had increased almost immediately.

DR. J. W. CHARLES thought rest was quite a factor in these cases and spoke of a young man who after being struck in the eye had had a marked hyphema. He was told to abstain from use of tobacco, but being an inveterate smoker he became quite nervous and restless, and when he was allowed to resume smoking his nervousness disappeared and he made an uneventful recovery.

DR. LAWRENCE T. POST described a type of injury not previously discussed. A young man had struck his brow a light blow against a hook which did not actually come into contact with the eye. He had noted immediately that he could not see out of this eye. X-rays revealed no fracture. He had been told by a company physician that there was nothing wrong with the eye. Two weeks later the pupil was widely dilated, reacted to consensual but not to direct light stimulus, and the fundus appeared normal. The case continued to complete optic atrophy.

Ultraviolet light therapy

DR. LAWRENCE T. POST reviewed his experiences with ultraviolet light therapy during the past five years. He felt that it was of benefit in many corneal conditions but he had not had success in treating deeper ocular lesions with local therapy alone. He thought that it was essential that abiotically active rays should be used and that for the determination of this activity skin erythema doses were necessary. Numerous examples of different types of lesion treated were given.

Discussion. DR. HILDRETH, who was a guest, told how his own interest in ultraviolet treatment had arisen through a case of dendritic ulcer cured by this type of radiation therapy after other methods had failed. A new ultraviolet ophthalmic lamp that he had devised was briefly described. It seemed to meet the requirements for local eye treatment better than others. The radiation, electrical, and mechanical features were mentioned, as well as clinical utility.

He outlined further studies to be made on various ophthalmic lamps, to analyze their spectra quantitatively. A photochemical substance known as lithopone was to be used. This material reacted only to the spectrum waves shorter than 3130 Angstrom units, which coincided well with the region of greatest biological effectiveness.

DR. M. H. POST said he had been much interested in the work on ultraviolet light and had been using the light for several years. A year ago he had presented a paper on the effect of ultraviolet light on five cases of dendritic keratitis, and two of which had shown definite improvement and one remarkable improvement. A uviol-glass filter had been used, and the exposures were for ten minutes.

He stated that Duke-Elder had noted the benefit derived from ultraviolet light therapy especially in the deeper structures, and he referred to Dr. Hildreth's case, in which two exposures to ultraviolet light resulted in prompt benefit and eventually almost entire disappearance of scarring, although the lesion had been an extensive one.

DR. W. H. LUEDDE said he had had striking success with the use of ultraviolet light in dendritic keratitis and in interstitial keratitis. He had discarded the water filter but continued the uviol-glass filter.

DR. JOHN GREEN reported two cases treated with ultraviolet light. The first case had apparently had a ring keratitis a year before and a pseudopterygium had formed which invaded the pupillary area and lessened vision. The patient had not been under Dr. Green's

care at that time. Later the patient had developed a peripheral ulcer of the cornea in the other eye. Despite all therapeutic efforts the ulcer began to spread around the corneal margin. Half-a-dozen exposures to ultraviolet light had resulted in complete healing. There had been no invasion of the cornea and the vision was later normal.

The second case had had herpes zoster ophthalmicus with deep lesions on the forehead and on the left side of the nose. The patient had been treated for a long time before being seen by Dr. Green. There had been a large central corneal ulcer with little tendency to heal. After several radiations of ultraviolet light numerous vessels had appeared deep in the stroma of the cornea and there had been complete restoration of epithelium of the wound. The vision had been impaired by the corneal scar.

DR. LAWRENCE T. POST said he believed there was a real advantage in the mercury vapor light, because the spectral range was narrower and apparently there was more efficiency in the ultraviolet from this source. In experimental work on animals in which the corneas had been exposed to the various rays and clinically and histologically observed, it had been noted that the only effective rays were those between 2400 and 3100 Angstrom units.

During his treatments the patients had suffered no discomfort and there had been no change in the eye for six or eight hours. Then the eye had become painful and the conjunctiva was swollen the next day.

DR. M. L. GREENE,
Editor.

CLEVELAND OPHTHALMOLOGICAL CLUB

October 14, 1930

DR. W. E. BRUNER, chairman

Injuries of the eye by glass

DR. M. W. JACOBY presented two cases of laceration of the globe by glass with iris prolapse. In one patient the lens capsule was ruptured. Prompt healing followed excision of prolapse and cov-

ering of wound with large conjunctival flap.

Dr. Jacoby said that in wounds produced by glass there was a greater tendency to laceration with less injury to underlying tissues than in metallic and other types of injury which usually penetrated and traumatized the deeper-lying structures. Extensive glass injuries or lacerations offered a better prognosis than similar injuries by other agents. A peculiarity of glass wounds was that the wound edges might be separated to their greatest extent. The speaker had found that because of this, when a deeply embedded particle of glass was lodged in the cornea, it might be freed and removed by irrigation. This method was much easier and safer than to risk entrance into the anterior chamber with instruments, and was practicable because the tissues did not grasp the foreign body tightly. Routinely all cases of laceration were examined by x-ray in search of glass, whenever there was even the slightest suspicion of its presence. Failure in localization was not due to the fact that glass was not opaque, but to the fact that the particle was probably too small or thin to produce a contrasting shadow against the denser shadow of the bones of the skull.

Discussion. DR. W. E. BRUNER had had a patient with an eye injured by explosion of a tungsten lamp, in March. He saw the patient again in April, at which time there was considerable injection. X-ray revealed three pieces of glass. The eye was finally enucleated.

DR. M. PAUL MOTTO described a similar case in which he later needled the cataractous lens as he thought the advantage of being able to see somewhat on the injured side was valuable even if the vision in the two eyes could not be accurately associated. He asked about corneal sutures.

DR. A. D. RUEDEMANN had recently treated two corneal injuries caused by glass. Because a conjunctival flap did not hold he made a corneal suture with a corneal needle and number three black silk. He removed some of the stitches in two days and the rest in

five. There was less scarring than after a conjunctival flap. The needle penetrated with difficulty but no vitreous was lost although the anterior chamber was empty in each case.

Prognosis in ocular trauma

DR. P. G. MOORE discussed foreign bodies in the cornea, burns, sharp blows on the eyeball, and penetrating wounds. He summarized as follows: Even the best efforts and immediate results obtained in the removal of a foreign body might later culminate in total loss of vision through some uncontrollable factor. These cases required conservative treatment and long observation, as a late reaction to the trauma might occur with additional impairment of vision. Small corneal scars, even when centrally located, caused little impairment and should result in little disability if properly handled. Burns were often deceptive in their primary appearance. Prognosis in intraocular foreign bodies was very uncertain.

Discussion. DR. A. B. BRUNER reviewed a case of traumatic cataract, removed without complication. Recovery was uneventful. Before discharge the patient was warned against exercising. When he left the hospital he ran for a street car, and he was back in fifteen minutes with a detachment of the retina.

Dr. Bruner believed that if a sharp instrument was used to remove a foreign body the eye should be kept under cover for some time.

DR. J. E. SPRINGER had been consulted by a patient who had had a corneal ulcer in the pupillary area for six weeks. The patient was hospitalized. Under dionin, scarring diminished and vision of 6/7.5 was obtained. Dr. Springer said that some claimed that rust spots on the cornea after removal of a foreign body were easier to take out after a period of from twenty-four to thirty-six hours.

DR. M. PAUL MOTTO stated that after removal of a foreign body leaving an obstinate rust stain, two percent tincture of iodine was better than mercuriochrome or argyrol.

DR. P. G. MOORE said he believed in removing the rust spots when the patient was first seen; the earlier they were removed the better because suffering from them was as great as if the foreign body had not been removed. In sterilizing a wound he never used anything stronger than zinc sulphate.

Bilateral congenital paralysis of the abducens

DR. W. H. PHILIPS told of a child who had the usual history of a convergent squint, beginning at the age of six months. On examination under atropin, the fundi were found normal. A diagnosis was made of congenital bilateral palsy of the abducens, and after some consideration it was decided to try to improve the appearance by advancement or tucking. Under local anesthesia bilateral resection of the external recti was done. As usual in such cases the muscles proved to be only thick fibrous cords. The patient did not take the anesthetic well, and just at the close of the operation she died. Undoubtedly, this was a case of mild status thymicolymphaticus. She was of the phlegmatic type, and a large thymus with hypoplastic heart and aorta was good evidence of the condition notwithstanding the absence of lymphatic hyperplasia.

Discussion. DR. A. B. BRUNER recalled a case similar to the one just presented. Bilateral resection of the external recti and tenotomy of the internal rectus on one side were done with good cosmetic result, but later the other eye diverged. He considered it better to do a simple recession of the internal rectus first, leaving any resection of the external rectus for a secondary operation.

Treatment of strabismus in children

DR. R. F. THAW said that definite measurements did not give definite results. The psychological effect of crossed eyes to the child was very destructive to character formation in the early years of life. It was more important to straighten a crossed eye from a psychological standpoint, and as to the

effect on character formation, than it was as a means of saving the vision in the crossed eye. These children should be operated on as soon as the strabismus was noticeable and if glasses failed to straighten the eyes in thirty to sixty days. A general anesthetic was preferable to a local anesthetic in either adults or children.

Pulsating exophthalmos

DR. GEORGE L. KING, JR., read a paper on this subject which will be published later in the American Journal of Ophthalmology.

Discussion. DR. W. E. BRUNER had had a case of traumatic pulsating exophthalmos, resulting from an injury by a wire nail which entered at a point between the orbit and the end of the nose. There was definite exophthalmos, considerable limitation of motion, and swelling of the lids with edema of the conjunctiva. The vision of the injured eye was 5/10, the fundi showed some congestion, pulsation was easily felt and bruit was readily heard. The outcome of the case was not known as the patient was not seen again.

DR. M. PAUL MOTTO some time ago had a patient manifesting a few characteristic symptoms, including pulsating exophthalmos, limited motion of external rectus, diplopia and diminution of vision. The nerve was injected and veins markedly engorged, with a later manifestation of small hemorrhagic areas throughout the fundi. The patient was uncooperative, and when last seen the nerve had become atrophic, with vision of only hand movements. At this time she refused further care, as her head noises had ceased and she felt fairly comfortable.

DR. M. PAUL MOTTO,
Secretary

CLEVELAND OPHTHALMOLOGICAL CLUB

November 11, 1930

DR. W. E. BRUNER, chairman

Tumors and pseudotumors of the orbit

DR. W. L. BENEDICT, of the Mayo Clinic, said there were several condi-

tions that had in common the production of exophthalmos, disturbances of ocular motility, and loss of vision. The differential diagnosis in a case presenting these findings in varying degrees required knowledge of local causes. Orbital tumor constituted one group of possible factors that must be considered. While tumors of the orbit were comparatively rare there was a wide variety of neoplastic diseases, some of which were metastatic, others were primary, and still others invaded the orbit by direct extension from the sinuses.

Osteomata of the orbit might be subdivided into exostoses, enostoses, and hyperostoses. Exostoses were small pointed or rounded excrescences on the surface of the bone, usually sharply circumscribed and without a covering. Such tumors were rarely seen. Enostoses were bony neoplasms that originated within the substance of the bone and developed into nodular masses composed of ivory-hard bone, cells of granular bone, and fibrous septi, the entire mass covered with a glistening moist membrane that separated the tumor from the surrounding bones and the soft tissues of the orbit. They originated in the sinuses about the orbit and extended into the orbit, where they replaced the orbital tissue and pushed the globe forward. They were easily recognized in a roentgenogram. Most of the bone tumors of the orbit were of this nature. They were easily removed when small. The large ones might extend into the cranial cavity in contact with dura over an area several centimeters in diameter. Removal of the large tumors was often a difficult procedure.

Hyperostoses were diffuse thickenings of bone proper, affecting most frequently the frontal and malar bones, but occasionally found as diffuse thickenings of most of the bones of the skull, as in leontiasis ossium. One bone alone might be affected. Inflammatory thickenings of bone were not to be confused with bony tumors.

A great variety of soft tissue tumors, many of them malignant, such as sarcomas, lymphomas, hemangiomas, and

others of mixed type, had their origin within the orbit or from nearby structures, such as the antrum. There was a large variation in rapidity of growth of these tumors as well as in malignancy. Fibromas were often mixed with bone, osteofibromas with sarcomas and hemangiomas. The fibrous group did not as a rule give rise to metastases, but might become increasingly malignant if disturbed by partial resection or improper radiation.

Metastatic tumors of the orbit were comparatively rare. More common were tumors within the globe, such as choroidal carcinoma, originating from carcinoma of the breast or the prostate or bowel. Lymphomas were often associated with enlarged lymph nodules elsewhere in the body. A conglomerate tubercle had occupied the upper temporal quadrant of the orbit in one of the speaker's patients. The pathology was not suspected, as there were no clinical signs of tuberculosis. Careful physical examination and Wassermann reaction should precede operation in all cases of suspected orbital tumor.

In considering the method of treatment it was first essential to rule out all possibility of luetic involvement. Duration and degree of exophthalmos would hardly prove a determining factor in estimating the size of an orbital tumor. The position of the tumor might be decided by palpation or by displacement of the globe. If tumors were not palpable, or if there was doubt about the presence of a tumor, radiation and medical treatment should be tried before surgical exploration.

The method of operating for tumors of the orbit depended on the size and position of the mass, the probable histopathology, and the patient's vision. Most tumors could be removed through an incision in the eyebrow. Incision through the lower lid should, if possible, be avoided because of small working space and the deformity caused by the scar. Resection of the lateral wall (Krönlein's operation) was a difficult procedure, but might be preferred for reaching tumors in the apex

of the orbit and in the lower nasal quadrant.

Radiation was better than surgery for types of hemangiomas that were known to respond well to radium. Undifferentiated glial tumors and sarcomas also yielded to radium. Often, however, one would find a mass so large that removal of the tumor was necessary to preserve the eye. Radium might then be used in the form of needles in the space occupied by the tumor or by surface application. Many pseudotumors would resist all treatment by radiation and medicine. After removal of the greater part of the contents of the orbit there was no further growth and the socket healed. From the viewpoint of technical surgery, the pulsating tumors of the orbit offered the greatest problem, since hemorrhage might be encountered, and unless the surgeon was equipped to control it grave difficulties might arise.

Discussion. DR. A. B. BRUNER had had a case in which only a small mass was found in the orbit, the eye being rapidly pushed forward. From biopsy the condition was diagnosed as neurofibroblastoma, so the patient was subjected to conservative treatment.

DR. A. D. RUEDEMANN had observed a case in which there were several tumors on the body, including one on the back, and a definite exophthalmos of one eye. The tumor on the back was treated with x-ray and the exophthalmos disappeared in two weeks. He had had another case, previously operated on for gastric disturbances and diagnosed as lymph hyperplasia. X-ray treatments made the patient so toxic that she died from an overdose of x-ray and not directly from the tumor.

DR. M. PAUL MOTTO asked whether Dr. Benedict generally used the method of exploration through the eyebrow or the Krönlein incision, and also whether he always found a similar picture in the fundus such as edema of the nerve and tortuosity of the veins or whether he found a somewhat white line which radiated in the region of the macula in orbital tumor cases. He also inquired whether there was generally

limitation of motion, particularly of the external rectus.

DR. BENEDICT remarked that exophthalmos sometimes persisted after an arrested thyroiditis and that it was difficult to tell until after considerable observation of thyroid function whether the exophthalmos was from an orbital or a thyroid condition. In his opinion cysts or lateral or nasal tumors were more accessible through the eyebrow. The Krönlein incision did not afford sufficient space to work freely. In this operation it was essential to get a good lateral resection of the orbital wall, and to save as much of the periosteum and the periorbita as possible, to provide nourishment for the piece of bone resected. As far as the fundus picture was concerned, choked disc simply meant that the subdural fluid was cut off by pressure. Light streaks inside the globe were indicative of a slight elevation of the choroid resulting in a light reflex due purely to change in the fundus. Limitation of motion depended upon the position of the tumor mass, causing displacement of the globe, crowding certain muscles, and interfering with their motion. However, it was far-fetched to state that the fact that in a certain region the muscles had restricted motility was a definite indication of the position of the tumor growth.

DR. M. PAUL MOTTO,
Secretary

ROYAL SOCIETY OF MEDICINE, LONDON

Section of Ophthalmology

January 9, 1931

MR. ELMORE BREWERTON, president

Marginal degeneration of the cornea

MR. DOGGART showed a patient, aged twenty-one years, who had complained of failure of vision in the left eye for a year, during which time he had had several attacks of mild conjunctivitis. There was a marginal opacity of the left cornea extending from the eight o'clock to the two o'clock position which was vascularised inward and

radially. These vessels were limited by a sinuous white line. The condition was probably prodromal to ectasia. Vision in the left eye was 6/9 with correction.

Discussion. SIR RICHARD CRUISE said this did not seem to him to be a degenerative condition but a sluggish form of subepithelial infiltration from an infective source. The lids were quite smooth.

Parinaud's conjunctivitis

MR. GAYER MORGAN presented a patient who was regarded as having Parinaud's conjunctivitis. He was found to be tuberculous by positive results from injection of some granulations into a guinea-pig. There were well-marked cockscomb granulations in the lower fornix and enlargement of follicles in the upper fornix over the tarsal plate. There was also a large gland under the angle of the jaw and a palpable preauricular gland. Commencing last March the eye had been exposed to a carbon arc lamp, first for one minute twice a week and increasing to two and one-half minutes twice a week. Improvement had been continual and now the gland, which had been large and soft, was small and hard and the tubercle had disappeared.

Discussion. MR. WOLFF said that in Parinaud's conjunctivitis there was a tendency for the conjunctival condition to get well but for the glandular condition to remain, either for a long time or permanently.

MR. GIMBLETT described a case of his own, of the same kind, which was reported to have a great excess of lymphocytes. The gland in front of the ear broke down and discharged, afterward healing, and the conjunctival condition subsided. That was three months ago.

MR. J. H. FISHER said it would be interesting to know whether the form of tubercle bacillus responsible in these cases was the bovine or the human. In ordinary glandular tuberculosis in children it was the bovine form, the infection taking place through the nasopharyngeal mucous membrane.

MR. P. G. DOYNE referred to three cases of the kind he had exhibited at the Section, in all of which there was a history of the conjunctiva having been scratched with the finger nail.

Color-blindness

MR. F. E. PRESTON showed a man who was dangerously color-blind according to the Edridge-Green test, but had been able to pass the test on railway signals, even in the recent dense fog and at a fair distance. There seemed to be a need for means of distinguishing dangerous from nondangerous color-blind people, since the chief requirement was to be able to tell red from green.

DISCUSSION. MR. ELMORE BREWERTON pointed out that even with the use of more than two lights in road signalling the tests should not be neglected.

A diplopia demonstrator

MR. LESLIE PATON showed a model he had just finished for the purpose of teaching students. By it students could easily be shown the types of diplopia caused by paresis of different muscles.

Extraction with conjunctival bridge

MR. NORMAN FLEMING read a paper and gave a cinematographic demonstration on his modification of this operation. He did a preliminary irrigation, cleaning out both fornices with swabs, mounted on Indian sticks, in a stream of saline solution. One advantage of this was that it obviated touching the palpebral conjunctiva with the fingers when everting the upper lid. Next, he opened the lens capsule by a slight curved vertical incision made with a Ziegler knife. This was not necessarily followed by any loss of aqueous. For the Graefe section he entered at the same point, and when cutting upward included a broad conjunctival band, between two parallel cuts 6 mm. in length. Then the knife was withdrawn from under the bridge.

For the removal of the lens an iris repositor which had its end bent to an angle of 90 degrees was introduced under the bridge, and the lens was pressed slightly downward by a stroking movement on the sclerotic. While it

was held in this position, a curette was applied to the cornea in order to make the lens present in the usual way. The iris reposer was then discarded, a needle was pushed into the lowest available part of the periphery of the lens, and with this the lens was rotated out of the eye without exerting further pressure. Any remaining lens matter was washed out if the operator wished, and the operation completed. He used the Madras bandage.

MR. FLEMING thought it would be agreed that, provided it was successful, cataract extraction without iridectomy gave the best result. So far, he had found that bridge extraction offered a safeguard against prolapse, because it fixed the lips of the wound and there was rapid healing, justifying omission of an iridectomy. The latter could, however, be done if desired, and more easily by fashioning the bridge somewhat to one side, as recommended by Mr. Leslie Paton.

Following this procedure, if all went well, 6/6 vision could be expected, as the bridge held the cut surfaces in good apposition and the wound healed very quickly with little reaction or astigmatism. In his last eighteen cases so treated there was one failure. The patient was an aged and decrepit woman who developed panophthalmitis within two days of the operation, though the culture was sterile. The infection was probably endogenous.

Discussion. MR. B. CRIDLAND mentioned his experiences in the industrial region of Wolverhampton. He had been operating by this method eight years. When he began he took fifty consecutive cases, and in nearly all of them did a simple extraction. Some of them were difficult to do, as more manipulation was required to get the lens out than without a bridge. In one he had to cut the bridge in order to get the lens out. But on the whole the results were eminently satisfactory. He had to deal with many men who were "squeezers," and this method was very valuable because if one released the lid and the patient squeezed it did not matter. During a discussion at the

Oxford Ophthalmological Congress the late Sir Anderson Critchett said he would be eclectic in deciding whether he would use a bridge and do an iridectomy or not, and the speaker had since adopted the same principle; he had tried to make a bridge but had not always been successful. This method reduced the stay of patients in the hospital; the average time in hospital of his fifty cases was only twelve days. He covered only the operated eye and patients were happier if allowed up on the second or the third day. Whether an iridectomy should be done or not depended in the incision, which might be in the cornea instead of at the limbus, and it was in such cases that prolapse was likely to occur.

MR. F. A. WILLIAMSON-NOBLE said he had been using an oblique bridge, cutting upward and outward all the time. Prolapse had occurred in one or two cases, and an iris reposer had been passed under the bridge, freeing the conjunctiva.

MR. M. S. MAYOU said that some years ago he had taken cultures from various parts of the conjunctival sac. The upper fornix, he found, was nearly always sterile, but usually the lower fornix and the caruncle contained organisms. He never turned up the lid to wash out the conjunctival sac, as this disturbed the patient before the operation and he thought it was unnecessary. The main attention should be given to the lower conjunctival sac.

MR. NUTT said that Mr. Pooley of Sheffield always made a bridge but not quite complete. This rendered delivery of the lens and the subsequent iridectomy much easier. It was a mere button-hole iridectomy but was sufficient to prevent the tendency to prolapse.

MR. AFFLECK GREEVES said the most important point about the conjunctival flap was to get a good fringe of conjunctiva all the way round, bridge or no bridge.

MR. LINDSAY REA said that operating with a drop of atropin in the conjunctival sac prevented prolapse afterward and that that was the routine method at his hospital.

COLONEL KIRKPATRICK said that producing paresis of the orbicularis by an injection into a branch of the facial was a help to a successful result.

MR. MALCOLM HEPBURN did not think that any kind of section would make any difference to prolapse of the iris as the latter depended on the condition of the iris.

MR. MAURICE WHITING said that Mr. William Lang always paid particular attention to the reaction of the pupil before doing his cataract extractions, and if the pupil was sluggish he did a complete iridectomy. Otherwise he did a simple extraction. In this respect the condition of the iris was most important.

SIR RICHARD CRUISE thought the most important thing in the prevention of prolapse was to saturate the eye with atropin beforehand and so to contract the iris into a peripheral ring. In his private cases he had not had to do iridectomy for prolapse for fifteen years.

Cataract from exposure to x-rays

MR. R. FOSTER MOORE described the case of a man aged twenty-eight years, who had been seen by dermatologists because of severe sycosis of scalp, face, and neck, of three years' duration. He had been to several hospitals, the treatment having included x-rays which the patient said made him worse. In this last treatment, because of certain risks attending the x-ray treatment, a signed statement was obtained from the man expressing his willingness to have the treatment. The disease affected the eyelashes as well as other parts of the face. The treatment lasted from February to June, 1927, and the total amounted to twelve Sabouraud doses. It completely cured the sycosis and there had been no recurrence. But telangiectases gradually appeared, and had remained apparently unchanged until the present time. In November, 1929, the patient's sight began to fail, the visual acuity in March of that year being 6/12 in each eye; since Christmas of that year he had been unable to read a book. In June, 1930, when Mr. Foster Moore saw him, the vision was only

6/60 in each eye, there was a plaque-like opacity in the posterior cortex of each lens, and bordering this was powdery opacity. The fundi were normal. Last May Mr. Moore had needled the right cataract and in October Mr. J. G. Milner had needled the other. The course was uneventful and after capsulotomy the acuity in the right eye was 6/6; absorption of the left lens was not yet complete but was running a normal course. Most of the opacity was in the lens substance adjacent to the posterior capsule.

Mr. Foster Moore referred to the first case of this kind reported in 1909 by Mr. Leslie Paton, and to others since. In all the recorded instances the dose of x-rays had been heavy and efficient protection of the eyes had not been possible. He commented on the length of time which had elapsed between the exposures and the affection of the lens, two and one-half years in the present case. He thought that even when the eyelids needed treatment a nicely-adjusted shield would give the eye the necessary protection.

THE PRESIDENT and several members agreed that every effort should be made in such cases to protect the eye itself from the irradiation.

(Reported by H. Dickinson)

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

February 19, 1931

DR. A. E. EUBANK, president

Operative treatment of ptosis

DR. ALVIN J. BAER read a paper on this subject.

Discussion. DR. ALBERT LEMOINE said he favored the Mottais operation where the superior rectus muscle was normal, as he had had very good results with this operation. Tarsectomy alone was enough in slight cases. He had never done the shortening of the levator and tarsus operation, but said that it sounded like a very good procedure.

ALVIN J. BAER,
Recorder.

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LAWRENCE T. POST EDITS THE AMERICAN JOURNAL OF OPHTHALMOLOGY

Beginning with the issue for July of this year, and including all matters relating to that issue, the editorship in chief of the American Journal of Ophthalmology will be assumed by Dr. Lawrence T. Post, Metropolitan building, Saint Louis.

For a number of years Dr. Post has rendered valuable service in the editorship of the Journal, and the retiring editor trusts that for the greater responsibility which Dr. Post now undertakes he will enjoy most abundantly the cooperation of the ophthalmologists of the United States and other countries.

The present editor, Dr. Crisp, will continue to edit the abstract department which has become an important feature of the American Journal of Ophthalmology. Communications with

regard to the abstract department should therefore still be addressed to him.
W. H. Crisp.

CYCLODAMIA

One of the most interesting papers read before the American Academy of Ophthalmology and Otolaryngology in Chicago last October was that by Dorland Smith on refraction without a cycloplegic, by a special method which the author first described in 1926 and for which he suggested the name of cyclodamia, the latter part of the word being derived from damnao, "I subdue," a name well chosen because it does not necessarily mean complete control.

The author states that this method often indicates the patients who really need cycloplegia as well as those who can be safely refracted without it, but he advises the continuance of routine cycloplegia as a check until those indications have been well learned by

* See announcement on this page.

experience, except of course in cases where for some reason cycloplegia is inadvisable. But it cannot be denied that such cases occur rather frequently, so it is most important to consider well any method that will greatly lessen or will overcome accommodative spasm.

The underlying idea of cyclodamia is that there is often greater relaxation when both eyes are considerably blurred than when sharp vision is allowed, and that the usual mathematical difference of correcting lens as between 20/200 vision and 20/20 vision is 1.50 diopter sphere. Therefore the lens required to give just 20/200 vision, reduced by 1.50 diopter sphere, will yield the lens that gives 20/20 vision if the same amount of relaxation is maintained. If this reduced lens does not permit 20/20 vision it is because more accommodation is again being used; the arbitrarily reduced lens may therefore represent a closer approximation to the real error than the lens with which 20/20 vision is actually obtained.

Smith's procedure is somewhat as follows: A quick glance is taken into the fundi to determine the presence or absence of gross pathology and to estimate roughly the spherical correction. A most careful ophthalmometric measurement is made. The correcting astigmatic lens is put before each eye and a rapid retinoscopy done. The patient is then placed at the trial case and spherical lenses sufficiently strong to blur each eye beyond 20/200 are put in the trial frame together with the astigmatic correction. Minus lenses are then added before each eye at the same time until vision reaches 20/200. Quick exclusion of each eye alternately shows whether vision is approximately equal in the two eyes. If not, equality is brought about by adding suitable spheres. This completes the cyclodamic test. The correction found less 1.5 diopter sphere should give 20/20 vision in each eye unless such vision stimulates greater accommodative activity. With this guide, the exact correction to be ordered is then determined by whatever method suits the convenience of the examiner.

That cyclodamia is of real merit in demonstrating unsuspected accommodative action and ciliary muscle spasm cannot be doubted. It is also true that a fair estimate of the amount of accommodative interference can usually be made. It will be found that in most young people the gradual addition of minus spheres up to 1.50 diopters to the cyclodamic correction will increase the vision from 20/200 to 20/30 or thereabouts, but that to clarify from this point to 20/15 requires much more minus addition than a mathematical progression would indicate, so that it is at this point, where maximum acuity is being sought, that spasm reveals itself most strongly.

This coincides with the author's experience and is an excellent argument for his procedure. However, the method is of little help in solving the important question of the exact axes and amounts of astigmatism, because these must be determined when the acuity has been sharpened and so at the very point at which accommodative action is greatest. In other words the method usually succeeds in revealing the presence of accommodative activity and indicates fairly well the extent of it, but, like all other noncycloplegic methods, in cases of true muscle spasm it does not relieve the spasm itself sufficiently for accurate refraction.

Cyclodamia is a helpful addition for necessarily noncycloplegic cases, and is worthy of the consideration of ophthalmologists. If it does nothing but suggest which patients are suffering from ciliary spasm and which most urgently need cycloplegia it will have real value.

Lawrence T. Post.

POOR VISION FROM AMETROPIA

Spectacles had been worn for poor vision for five hundred years before the medical profession discovered that errors of refraction and excessive demands on accommodation caused headache and the other symptoms of "eye-strain." The mass of medical men still think of indigestion, toxemia, Bright's

disease, high blood pressure, brain tumor, acute fever, and cold in the head as causes of headache before they think of an ocular origin for it; although cases from eye-strain outnumber those from all other causes. As to poor vision, if an ophthalmologist cannot find some pathologic condition to account for it, such as cataract, corneal scar, trachoma, amblyopia, vitreous opacities, or optic nerve atrophy, he is apt to think it is not worthy of his attention. By the older general surgeons who taught ophthalmology, these surgical diseases were known and were dealt with in one or two lectures of the course on surgery, while they still followed Professor Beer's advice never to wear glasses if it could be possibly avoided. If none of these conditions properly amenable to surgery was present, poor vision was considered as probably due to old age, and could be left to the opticians to attend to by fitting glasses.

Yet if one or more of the surgical conditions that cause poor vision is present, the poor vision may still be due to ametropia; and this will not be discovered by short-cut, easy-money methods of doing refraction. It is not likely to be brought out by the technician, or junior assistant, on whom is thrown the bulk of refraction cases. One obvious cause for poor vision is likely to stop the search for other, less interesting possible causes; especially if refraction is regarded as a side line not worthy of the serious attention of an ophthalmic surgeon who is more interested in the technique of muscle operations or in obtaining a reputation for skill in removing cataract.

Such an ophthalmic surgeon is likely to be deficient in the technique of measuring the refraction of eyes with poor vision; and this technique will never be understood by the average optician-optometrist, who is more interested in selling his customer a pair of glasses advertised like a patent medicine, under a copyrighted name, and mounted in frames that conform to the latest fad. The examination for ametropia with poor vision must depart from any general routine method of measuring re-

fraction. Opacities of the cornea, lens, or vitreous, as well as high aberration and irregular astigmatism, all interfere with or quite prevent the objective measurement by the ophthalmoscope or by skiascopy. Corneal irregularities exclude measurement with the ophthalmometer, and irregular refraction in the crystalline lens may make the ophthalmometric findings entirely misleading.

Low visual acuity makes it essential to resort to changes in the lenses before the eye which are greater and more sudden than those which are useful before eyes that have nearly full vision. Instead of changes of 0.25 or 0.50 D. in the spheric lenses before the eye, changes of 1, 2, 5, or even 10 D. may be necessary in order to obtain from the patient any positive evidence that one lens is better than the other. Such changes must be made by supplementary lenses held in the hand and instantly alternated. A cross cylinder, made by holding a -3 . cylinder and a $+3$. cylinder in the hand together, with their axes at right angles, and rotated so that their axes will alternate in direction, will sometimes show in one direction an improvement in vision such as indicates astigmatism whose correction is quite worth while. This was done in the striking case reported on page 537 of this issue of the American Journal of Ophthalmology.

When once regular astigmatism has been discovered in this way, along with the patient's appreciation of the improvement in his vision, the case becomes an interesting one; and the necessary repetition of tests to bring out his best vision becomes profitable. A patient known to have high myopia, and wearing -10.00 D. spheres, may obtain more improvement in vision by making the lens -20.00 D., or perhaps by adding a high cylinder, than he would by an operation that prevented him from going blind with glaucoma, or a treatment with malaria that checked his optic nerve atrophy. Even though a myope has vitreous opacities, or choroidal atrophies, he has a right to full correction of his myopia; and from

this at the same time he will obtain the best vision and the best security against further degenerate changes, despite the teaching of Professor Beer and of some of his German followers who still fear full correction of myopia, forty-five years after Professor Foerster of Breslau tried to teach the truth about this. Even when lens opacities are also present, there is no reason why full correction of ametropia should be withheld.

If a patient has corneal scars and high irregular astigmatism perfect vision may be impossible; and yet correction of the regular astigmatism present, with addition of the strongest convex spherical that does not blur vision, may make the eye so much more useful as to provide an important service. The presence of pathologic changes in the eye is no reason for withholding correcting glasses, but is an added reason for making even greater efforts to bring the eye to its maximum of efficiency. Even glaucoma has sometimes been checked permanently by correcting hyperopic astigmatism and the associated strain upon the small amount of accommodation still remaining. The prescribing of correcting glasses must be accepted as a very important part of the service undertaken by the ophthalmologist, "ophthalmic physician", or "ophthalmic surgeon." His obligation is not cancelled or reduced by the fact that other conditions are present which he is unable to control or remove.

Edward Jackson.

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The patent medicine and the counter-prescribing druggist have been particularly offensive forms of quackery. But the medical profession as a whole, by the prescription written in Latin, delivered as the climax of applied wisdom in each case, has fostered the superstition that the proper way to seek health was to swallow something that came out of a drug store. Operations in the hands of untrained surgeons have served the uses of quackery ever since Lister made it relatively safe to cut and sew the human body. There is danger

that similar superstitious faith may be attached to the wearing of glasses.

Most of the present popular errors about medicine have taken their origin in teachings of the medical profession; which, often incorrect to start with, take hundreds of years to disappear from popular tradition and belief. When spectacles were first introduced, it was with very little knowledge of what they were needed for, or how they could help sight. They were worn for ornament, or a kind of magic, or because they were the latest style. Probably there was reason for the chapter in Beer's book on "Present rage for wearing glasses."

In the fifty years since the medical profession began to be interested in errors of refraction and accommodation, spectacles have been accepted only partially as a medical resource. Headaches are still treated by aspirin, or the newest coal tar derivatives, that are still claimed to be free from the "habit-forming danger." Or the "doctor" wears glasses given to him by an enterprising optometrist, while he declaims against the counter-prescribing druggist. Quackery flourishes in the borderland of medical knowledge. Electricity, physiotherapy, the x-ray, massage, osteopathy, chiropractic, and the ultraviolet radiations that confer marvelous properties on a certain cigarette, divide popular favor with the drug-store substitutes for narcotics. It was too much to hope that spectacles would not attract the attention of quacks.

When printing was invented, it became so easy to reproduce any writings that laws were devised to protect the interests of authors in their own productions. After it was shown that copyrights could have and protect property values, they were sought for the purpose of creating and perpetuating trade monopolies. Practically no "patent medicines" are patented. They are made and sold under copyrighted names. A patent is granted on a published specific description of the thing for which the patent is sought. The copyrighted name, used as a trademark, can be given to whatever the owner of

the copyright chooses to sell under it. For medicines the copyright became popular because it allowed secrecy and false claims based on some secret ingredient or process. The secret, proprietary, widely advertised "patent medicine" might be as good a preparation as could be compounded from the same drugs by a skilled pharmacist. But the elements of secrecy and of misrepresentation in the interest of manufacturer or salesman, as well as the opportunity to sell at one time under the advertised name, something different from what had been sold under that name before, placed it out of the class of drugs that could be prescribed and relied on by the careful, conscientious physician.

So numerous did these pharmaceutical preparations become, so blatant were the claims made for them by the proprietors of their copyrighted names, so often were they introduced by being pressed on the attention of physicians, and so often were they later advertised to the public in the daily papers, that the American Medical Association was compelled to establish its Council on Chemistry and Pharmacy, whose function is to examine and pass upon the character and claims of every drug with a copyrighted name that is advertised to the profession or the public. The work of the Council has done much to limit this abuse of copyright laws; although the opportunity to advance false claims under a copyright name is still attractive enough to keep up the fraudulent practice wherever the medical profession is not sufficiently watchful.

Recently the great manufacturing optical companies have shown a disposition to follow the example of the chemical works manufacturers and dealers, by putting out their spectacle glasses under copyrighted names. Sometimes it is the special curves they have calculated, but have not published, for which they claim a magical accuracy which sounds good to the eye physician or the cataract surgeon who is not particularly familiar with mathematical optics. Sometimes it is the wonderful polish of the copyright lens that is em-

phasized; but most frequently it is the chemical composition that will avoid "glare" for eyes protected by glass sold under the copyrighted name. But in all cases the real objective is an increase in the income of the makers and vendors of these glasses, to be attained irrespective of the intelligence of the oculist or the financial interest of the wearer.

Various remedies are possible for this abuse of advertising opportunities to add monopoly profits to those of legitimate trade. Since the counter-prescribing druggist has sometimes been induced to include spectacles among his proprietary remedies, the Council of Chemistry and Pharmacy might extend its field of operations so as to include glasses sold under copyrighted names. The Bureau of Standards might be authorized to test the various glasses manufactured under copyrights. Or the American Committee on Optics and Visual Physiology might be directed to take the matter up. But an intelligent interest in the scientific facts regarding the refraction of oblique pencils of rays, and as to the selective influence of glasses on light and various other radiations associated with light, would prevent ophthalmologists from assisting the pursuit of added profits through unethical advertising and abuse of the laws relating to copyrights.

Edward Jackson.

BOOK NOTICES

The principles and practice of perimetry. By Luther C. Peter, professor of ophthalmology in the graduate school of the University of Pennsylvania, etc., etc. Third edition, thoroughly revised. 306 pages, 194 engravings, and 5 colored plates. 1931, Lea and Febiger, Philadelphia.

It is a high compliment to the author that this monograph on a special branch of ophthalmology and neurology, originally based upon a course of lectures given at the graduate school of the University of Pennsylvania, has already reached a third edition.

Incorporated in the new edition are discussions of special topics which have

been emphasized in recent literature, including experimental work on the projection of the retinal fibers along the visual pathway, new perimetric apparatus and technique, and the newer thought and experience with regard to the fields in glaucoma, the central or cecocentral scotomata of toxic amblyopia and nasal sinus disease, and visual field changes in the amblyopia of squint.

The writings of other authors on their particular topics are freely quoted, with due acknowledgment. The value of some of the new and expensive apparatus for perimetry is carefully appraised. Special attention is called to the author's method of anatomic or physiologic recording of the fields; according to which the chart represents the patient's field as viewed by the examiner in a position facing the patient, instead of depicting the field as looked at by the patient himself.

This volume has served and will continue to serve, not merely as a guide to careful technique, but as a source of reference with regard to conflicting theories and scientific experimentation in difficult problems of ocular and cerebral diagnosis. *W. H. Crisp.*

An atlas of stereophotographs of the anterior segment, second series. Robert Von der Heydt, M.D., and Harry S. Gradle, M.D. Fifty plates and test cards. Price \$16.00. Published by the authors, Chicago.

Probably few of us have fully realized the educational possibilities of stereoscopic photographs. Especially in teaching those who are unfamiliar with the conditions depicted, a good illustration, and particularly a stereoscopic pair of photographs, with its faithful indication of the relative depths of different structures, possesses some distinct advantages over even careful examination of the living subject. The photograph may be examined as long and as frequently as is desired, whereas the owner of a congenital anomaly or the sufferer from some disease of the anterior segment may become intolerant of illumination and manipulation.

This second series of fifty stereoscopic photographs has the splendid quality of the first series; and each pair is carefully described on a separate card. Among the many interesting conditions illustrated may be mentioned ectopia lentis, persistent pupillary membrane, embryotoxon, glass within the corneal scar, steel in the iris and in the lens, gunpowder under the conjunctiva, traumatic rupture of the anterior capsule of the lens, traumatic rupture of the iris, pediculosis of the eyelashes, molluscum contagiosum, rosacea keratitis, tuberculous keratitis, dendritic keratitis, separation of the epithelium of the cornea following a fistulization operation, central atrophy of the iris, vascular tumor of the iris, melanoma of iris and sclera, and sarcoma of the ciliary body.

The photographs and the descriptive cards are conveniently fitted into a strong, leatherette-covered box.

W. H. Crisp.

Hereditary optic atrophy (Leber's disease). Julia Bell, M.A., M.R.C.P. Paper, quarto, pages 325-423. Frontispiece portrait of Leber, and pedigree plates. Figures 704-941. Cambridge University Press, London, 1931.

This is part 4 of the Nettleship Memorial Volume, *Anomalies and Diseases of the Eye*, and is a part of "The treasury of human inheritance," edited by Professor Karl Pearson, F.R.S., from the Francis Galton Laboratory for National Eugenics of the University of London. An outline of the history is followed by an account of the disease, including: the sex incidence, the character of the onset, and the age at which it occurs; the clinical signs and symptoms of the disease; the course and prognosis; and the association of other disabilities. The final section deals with the hereditary character of the disease and its mode of transmission.

After the name index there is a bibliography extending from Beer in 1817 through 153 titles to Ida C. Mann and H. M. Traquair in 1928. The descrip-

tions of pedigree plates occupy sixty-six pages, constituting a most interesting and complete yet condensed statement of characteristic and incidental features of this disease as it has been observed. This statement cannot fail to awaken a keen interest in those heredity and unfavorable influences which result in this disabling departure from normal development and sustained health.

The pedigree charts exhibit graphically a great number of detailed observations extending over seven, eight, and even eleven generations. It is significant that the new science of eugenics finds in ophthalmology its most extensive, exact, and important groups of data. The ophthalmologist has the opportunity of observing some of the most common and important fields of clinical fact from a new and suggestive point of view. *Edward Jackson.*

Cuerpos extraños endo-oculares. (Intraocular foreign bodies.) Thesis by Dr. Jose Alberto Sena. 215 pages, 156 illustrations. Imp. Frascoli y Bindi, Buenos Aires, 1931.

This 220-page monograph approaches the subject from practically every angle, with a discussion of the various injuries and results of treatment from their development by Fallopius in 1589 down to the present time. The author did a considerable amount of research on rabbits into whose eyes he introduced various types of foreign body. After making detailed external examinations for a sufficient time, the eyes were enucleated, and the histological findings correlated with the clinical.

Copper particles in the anterior chamber became enveloped in a light yellow exudate within twenty-four hours, the entire iris being deeply congested. Two months later the exudate had largely disappeared, the eye having become somewhat tolerant to the foreign body, which had in the meantime become encapsulated. Histologically there was found a considerable fibrinocellular infiltration around the particle, Descemet's membrane and the adjacent portions of the cornea having been de-

stroyed so that perforation was imminent. The adjacent iris was congested, but neither lens, retina, nor choroid was altered.

The experimental results with iron yielded results along familiar lines.

A lead shot weighing 20 mg. was placed in the anterior chamber. Two months later there was scarcely any reaction. A similar body was placed in the posterior chamber, and could be seen to change its position with the inclination of the head. Twenty-five days later the eye was sectioned and the particle was found free in the vitreous. There was no visible gross alteration. On microscopic examination there was a slight retinochoroidal infiltration, but no anterior change.

It was noted that the left eye was usually affected by foreign bodies, the fact that the majority of workers are right handed serving to protect the right eye. Even aseptic particles in the ocular interior may give rise to inflammatory reactions, which vary with time, location, and chemical composition. Incandescent particles are always aseptic. Those portions containing the richest blood supply react most severely, e.g. the ciliary region, choroid, and retina, the delicate elements of the last being especially susceptible to chemical irritation. With the exception of cataract production, the lens is quite tolerant of foreign body inclusion. The type of wound, the force exerted, and the size and shape of the foreign body all exercise an influence on its effects. Gold, silver and glass are classed with the chemically inert, but even these are not devoid of action. Siderosis appears especially in certain tissue or cells, such as the ciliary epithelium, the retina, and the lens capsule.

The symptoms are divided into those of probability and those of certainty. Considerable space is devoted to the sideroscope, the magnet, and radiography.

The treatment summarizes present views somewhat in detail, but without the addition of anything original. Considerable emphasis is laid on both the prophylactic and the direct therapeutic

aspects of milk injections. There is a review of forty-five cases, and a large bibliography, mostly from European sources.

A. G. Wilde.

CORRESPONDENCE

The negative phase of contagion in trachoma

To the editor:

Ten years having elapsed since the publication of my paper with the above title (1920 Transactions of the American Academy of Ophthalmology and Otolaryngology), and the search still going merrily on for proof of the positive phase, it seems not inappropriate to suggest a reconsideration of my findings in the follow-up, to the third and fourth generations, in certain trachomatous families, where treatment and prophylaxis (especially the latter) played minor rôles. With these findings we have the reverse of the picture, namely, the practically spontaneous disappearance of the disease when the scale of living has been raised to a healthy level.

In connection with the obverse, which now shows trachoma en masse confined to the primitive peoples (including the crowded tenements of the slums, or trenches of warfare), the deduction follows that, if the epidemiology and etiology of this disease are to be encompassed, an evaluation of malnutrition, associated with unclean living, is obligatory; and the more particularly because there is little doubt about its relation to the communicable diseases for which characteristic germs have been isolated. Furthermore, as a corollary, it is to be noted that infections from these characteristic germs, whether by manual contact, insufflation, or through an intermediary host, may be seen quite as often in the well-to-do as in those ill equipped.

The contemplation of these features alone should give pause to the believers in contagion. But they should also be aware that they are indulging in as-

sumption so long as there is a modicum of uncertainty in the differentiation between folliculosis which is trachomatous and that which is not. Nor is it sufficient, as emphasized, to answer that trachoma is occasionally seen in the well set-up people, whose business takes them into places where the disease is rife. These unfortunates, while naturally shunning contact with people, will as naturally be subjected to contact with the pests of the environment, the bedbugs, flies, and "cooties"; and this, despite the "not proven" verdict for certain flies, raises the question of an undiscovered intermediary host. The late Dr. Myles Standish confessed a large suspicion of the bedbug in this capacity.

The hope that "springs eternal in the human breast" will doubtless lead the believers in contagion to further search for a specific germ; pointing, for justification, to the eventual discovery of the spirochete. But a way to differentiate folliculosis—clinically if possible, or in the laboratory if need be—is almost equally a desideratum. Kleczkowski claims that he has found it in his serum test; and it is to be hoped that this will be confirmed, because inoculations with bacterium granulosis have been far from convincing.

Then, with the widespread endorsement of tarsal plate resection as a therapeutic measure, it becomes almost impossible to ignore the postulate of Burleson, namely, that trachoma is the end result of neglected or overtreated infections from familiar germs.

Such concerted investigation would have an advantage over collective investigation in that the danger of seeing, in the latter, the problem from only one angle would be reduced by the necessity of a meeting ground for those who have confidence in their ability to diagnose trachoma in the initial stage and those who must wait for the second stage—months later.

H. B. Young.

Burlington, Iowa.

ABSTRACT DEPARTMENT

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is only mentioned in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

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| 1. General methods of diagnosis | 9. Crystalline lens |
| 2. Therapeutics and operations | 10. Retina and vitreous |
| 3. Physiologic optics, refraction, and color vision | 11. Optic nerve and toxic amblyopias |
| 4. Ocular movements | 12. Visual tracts and centers |
| 5. Conjunctiva | 13. Eyeball and orbit |
| 6. Cornea and sclera | 14. Eyelids and lacrimal apparatus |
| 7. Uveal tract, sympathetic disease, and aqueous humor | 15. Tumors |
| 8. Glaucoma and ocular tension | 16. Injuries |
| | 17. Systemic diseases and parasites |
| | 18. Hygiene, sociology, education, and history |

1. GENERAL METHODS OF DIAGNOSIS

Spiller, W. G. **The Argyll Robertson phenomenon.** Arch. Neurology and Psych., 1930, v. 24, Sept., p. 567.

The definition of the Argyll Robertson pupil is usually that the pupil does not respond to light but does respond in accommodation and convergence. But an incomplete Argyll Robertson pupil has much the same clinical value as the completely developed phenomenon which is generally recognized as the Argyll Robertson pupil; although ordinarily this preliminary state is ignored. It would be possible to speak of the phenomenon as reflex rigidity to light, yet it seems desirable to retain the name of one who made a brilliant clinical discovery, and to speak of the preliminary state as an abortive Argyll Robertson reflex.

When optic atrophy is present and an Argyll Robertson pupil is observed, a false interpretation may be made and the latter phenomenon attributed to a gross lesion in the terminal portion of the tract of the "pupillary fibers" in the region of the corpora quadrigemina, whereas it is quite as likely that these fibers have been damaged in either the optic nerve or the optic tract.

A case is reported to illustrate the complexity of reactions that one may get in a given case and the conclusion that may be drawn therefrom.

Ralph W. Danielson.

2. THERAPEUTICS AND OPERATIONS

Green, John. **Two percent epinephrin solutions as substitutes for levoglauco-san.** Arch. of Ophth., 1931, v. 5, March, pp. 350-353.

The author offers a substitute for levoglauco-san. He calls attention to several objections to the latter. It is supplied in small ampoules which can be opened only with difficulty, usually resulting in the loss of several drops. It causes a whitish, granular deposit on the cornea. The price in this country is very high.

Various solutions have been tried as substitutes. At present, the author is using a two percent solution of supranen bitartrate, supplied him in ampoules, or in powder form in ampoules, for immediate solution in distilled water. In fifteen cases so far treated with these preparations, mydriasis of varying degrees has been produced. This is most marked in glaucomatous eyes. There has resulted ischemia of the conjunctiva, but not of the skin. In most cases, the tension in glaucomatous eyes has been lowered. After several instillations, the corneal epithelium is somewhat roughened, but there have been no white granular deposits. There have been no systemic effects. Some burning pain is experienced on instillation. In sensitive patients, a few drops of holocaine may be instilled before the use of the adrenalin solution.

M. H. Post.

Hartgraves, H., and Kronfeld, P. C. **The synergistic action of atropin and epinephrin on the intrinsic muscles of the eye.** Arch. of Ophth., 1931, v. 5, Feb., pp. 212-218.

Poos introduced the following classification of drugs with regard to their action on the intrinsic muscles of the eye: (1) Drugs with one point of action: (a) increased tone of the sphincter, pilocarpin, physostigmin, cholin, insulin; (b) paralysis of the sphincter, atropin, scopolamin, and their substitutes; (2) Drugs with two points of action: (a) active relaxation of the sphincter and stimulation of the dilator, epinephrin, cocaine, ephedrin.

The combined action of any of the drugs of the atropin and epinephrin groups is one of the most marked examples of synergistic effect in ophthalmology. The result of the combination of atropin and cocaine is more marked than the added effects of the two components. The foregoing facts are established with regard to the iris, but not so definitely in the case of the ciliary muscle. To investigate the question whether cocaine or ephedrin increase the effect of atropin upon the ciliary muscle and produce more constant data for refraction than atropin alone, the present authors made observations of refraction under cocaine or epinephrin, or both combined, after complete atropinization, comparing the results thus obtained with those found from the use of atropin alone, and finally studying the refractive results under epinephrin alone, as compared with those under atropin alone.

The authors conclude that there is no noticeable change in the static refraction when either or both drugs are added to the usual administration of atropin. The same was true with regard to combinations of these secondary drugs with homatropin.

M. H. Post.

3. PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Blatt, Nikolaus. **Cyclic weakness of accommodation with dysmennorrhea.** Zeit. f. Augenh., 1931, v. 73, Jan., p. 166.

A measurable weakness of accommodation occurred regularly with menstruation in a nineteen-year-old girl with dysmennorrhea associated with general neurotic manifestations. A theoretically plausible explanation is that the accommodative weakness results from the same derangement of central nervous function as causes the dysmennorrhea. *F. H. Haessler.*

Blatt, Nicholas. **Weakness of accommodation.** Arch. of Ophth., 1931, v. 5, March, pp. 365-373.

For measurement of anomalies of accommodation, the author has devised an instrument called the accommodatometer, similar to Landholdt's ophthalmodynamometer. This instrument consists essentially of a metal box lined with translucent white glass, in the center of which there is an electric light, the whole mounted on one end of a rule 70 mm. long. On the other end is mounted an eyepiece containing a single cell in which lenses correcting the refractive error of the eye to be examined may be inserted. Through three sides of this metal box, small holes are made, one above the other, graduated to three different sizes; the smallest corresponding to the lumen in the O of the Snellen 0.5 meter type; the second, to 0.8 meter; and the third to 1.25 meter. The finest holes are used in cases of normal vision, the intermediate ones with those having somewhat reduced vision, and the largest where the vision is poor. While the patient watches these holes, the box is brought up until the light from them blends into a solid streak. This is regarded as the near point. The fourth side is arranged in such a way that the various Snellen types can be exposed one line at a time, and the near point is regarded as that distance at which type similarly selected can just be read. With this apparatus, the accommodation and the exhaustion curves are easily plotted.

The author has found weakness of accommodation occurring in many exhaustive conditions such as fevers and physical strain; also in some local conditions such as glaucoma and iridocy-

clitis. Finally, the writer asks how do endogenous and exogenous toxins act in order to produce weakness of accommodation, and how and in what part of its physiological activity is the ciliary muscle changed so as to produce these delicate disturbances of accommodation. In order to approach an answer, the action of the muscle is divided into its two component parts, a kinetic element which produces movement, and a tonic element which maintains the function of the muscle while acting. In weakness of accommodation, the tonic portion has been lost, while in paresis both portions are decreased or lost. The function of each part of the muscle is influenced by the center of accommodation, the assumption of the presence of which the author feels to be justified on theoretical grounds. Toxins produced in the course of various disorders may alter or limit its action, leading to disturbances of ciliary activity affecting either one or both portions of the ciliary muscle, and thereby producing either weakness or paresis of accommodation. *M. H. Post.*

Christie, William. **Color-blindness in school children.** *Med. Jour. Australia*, 1930, v. 1, Feb. 22, pp. 247-255.

This is a rather lengthy and complete discussion of color-blindness, along with a description of research work done on 20,000 school children. The tests used by the author were Ishihara's color plates, the wool test, and the solar spectrum.

Christie points out that color-blindness is somewhat relative, for many so-called normals cannot distinguish indigo in the spectrum. The author says that some writers refer to a peculiar look in the eyes of a color-blind person, but after examining about 1,000 affected persons with about 1,300 examinations and reexaminations the author had not seen it. Many interesting examples are cited in which color-blindness not only interfered with the patient's school work and his safety, but also caused him to become involved in amusing situations. The problem of finding suitable

work for these afflicted people is discussed.

This paper cannot be adequately abstracted; it should be read in full by those interested in the subject.

Ralph W. Danielson.

Granit, R., and Harper, P. **Comparative studies on the peripheral and central retina: 2. Synaptic reactions in the eye; 3. Some aspects of local adaptation.** *Amer. Jour. Phys.*, 1930, v. 95, Oct., pp. 211 and 241.

These papers are résumés of the literature and reports of research done on the subjects indicated in the title. Most of the conclusions are too technical to be removed from context for purposes of abstracting.

The first paper has this significant paragraph: Parsons, considering peripheral daylight vision as contrasted with central vision, once remarked that there was overwhelming proof that peripheral vision behaved in exactly the same manner as central vision, but with diminished sensitivity; and that, if the stimuli were sufficiently great, the fields of vision for colors extended to the extreme periphery. The great summative power of the periphery seems to afford the clue to a solution of this problem. If the stimuli are strong enough, the summation in the outer parts of the retina will compensate—or even overcompensate—for any lack of sensitivity. It has long been known and has been repeatedly confirmed that the peripheral color fields can also be greatly extended by increasing the areas employed.

Ralph W. Danielson.

Granit, R., Hohenthal, T., and Uoti, A. **On the latency of negative after-images in relation to brightness of stimulus.** *Acta Ophth.*, 1930, v. 8, p. 137.

This is a study of the influence of (1) the intensity of the stimulus and (2) the state of adaptation upon the latent period of the after-images. The illumination was controlled by means of Tscherning's neutral-tint glasses. For each intensity used the latency was measured at different distances from

the fovea. The article is illustrated with plotted curves, relating the latent period of the after-images to the visual angle subtended by the distance from the center of the stimulus to the fixation point. The curves show that the latent period shortens from a high value in the middle of the fovea toward a paracentral point; that it then rises to a second maximum at about $1^{\circ}50'$ of the visual angle; and that this is followed by gradual shortening of the latent period toward the periphery, where the high intensity curves show a renewed rise. The course taken by the curves is explained by the distribution of rods and cones in the retina. In the middle of the fovea weak stimuli elicit no after-image. The latent period increases with the intensity of the stimulus in any part of the retina, except perhaps at the edge of the fovea. Stronger stimuli cause lengthening of the duration of the after-images. The effect of dark adaptation is entirely negative. *Ray K. Daily.*

Kanner, Leo, and Schilder, Paul. **Movements in optic images and the optic imagination of movements.** Jour. Nervous and Mental Dis., 1930, v. 72, Nov., pp. 489-517.

This is a detailed report of work done and conclusions drawn on the subject of memory images, eidetic images, and after-images. (Complete bibliography.)

Ralph W. Danielson.

Krakov, S. W. **The dependence of visual acuity upon a sound stimulus.** Graefe's Arch., 1931, v. 124, p. 334.

The visual acuity was found by experiment to be affected by an acoustic stimulus in the tested individual without regard to whether the pupillary reflex was active or not. In differentiation of two black points upon a white background the visual acuity was increased through a sound occurring simultaneously; in differentiation of two white spots upon a black ground the visual acuity was thereby diminished. Both the stimulating as well as the inhibiting effect of sound upon the visual acuity continued for some time after the sound ceased.

H. D. Lamb.

Lain, E. S. **Nickel dermatitis: a new source.** Jour. Amer. Med. Assoc., 1931, v. 96, Mar. 7, p. 771.

Three cases of nickel dermatitis due to new white gold spectacle frames are reported. The lesion consisted of a marginated erythema with medium-sized, pruritic papules extending horizontally over the temples and behind the ears, corresponding with the temples of the glasses. Eruptions occurred after a period of warm days during which the patients had perspired freely over the temples.

The author is of the opinion that this condition is probably more common than the literature would lead one to infer.

George H. Stine.

Marquez, M. **Concerning anaglyphic stereoscopic vision.** Arch. de Oft. Hisp.-Amer., 1930, v. 30, Sept., p. 495.

The subject of anaglyphs has not received the attention it deserves in ophthalmologic literature. It finds its application in fundus photography as worked out by Lijo Pavia as well as in reproduction of tridimensional objects and in the teaching of solid geometry. Common usage has sanctioned the use of the term stereoscopy in application to the illusion of depth secured in various ways in looking at plane figures. Properly speaking it is pseudostereoscopy, and the term stereoscopy should be reserved to the sensation of relief in normal binocular vision. With good fusion power the illusion of relief can be achieved without the stereoscope. The required conditions are (1) accommodation for the plane of the stereogram, (2) convergence either in front of or behind the plane of accommodation, (3) the induction of "nystagmus," as it were, of convergence, that is, a capacity for rapid oscillation of convergence. While localization of the image is in the plane of the stereogram in either case, divergence is employed in the use of the stereoscope, and convergence when no apparatus is used. While in the construction of anaglyphs the principle of convergence is generally used, divergence may be employed. Illustrations of an anaglyph and the theories applied

to stereoscopic vision without a stereoscope accompany the article.

M. Davidson.

Preston, H. G. **The crossed cylinder—a plea for its more general use.** *Virginia Med. Monthly*, 1930, v. 57, Dec., p. 567.

Preston says that it is difficult to understand why an instrument so accurate, inexpensive, and simple should have received so little attention and publicity as the crossed cylinder. It is not necessary to know the physics involved to be able to use it expertly. It is particularly adapted to small errors in children and materially lessens the time required for such determination.

The author describes the steps taken in working out a given error of refraction. Diagrams previously arranged by Crisp are used as illustrations. A bibliography of eight references is given.

Ralph W. Danielson.

Raubitschek, E. **Short practical directions for retinoscopy with cylinders.** *Zeit. f. Augenh.*, 1931, v. 73, Jan., p. 143.

The author describes as briefly as possible what is seen in each possible situation, what conclusions can be drawn from the observation, and what to do next.

F. H. Haessler.

Smart, F. P. **Crossed cylinders in refraction.** *Virginia Med. Monthly*, 1930, v. 57, Nov., p. 506.

An enthusiastic user of the cross cylinder here attempts to give a lucid and simple description of the technique. This is largely done by citing and solving specific cases and experiments. One illustration is given consisting of a series of test cards as they appear when observed through the cross cylinder in different positions; this clearly demonstrates the instantaneous contrast which is the chief feature of the instrument.

Ralph W. Danielson.

4. OCULAR MOVEMENTS

Friesner, I., and Druss, J. G. **Osteitis of the petrous pyramid of the temporal bone associated with paralysis of the ex-**

ternal rectus. *Arch. of Otolaryng.*, 1930, v. 12, Sept., p. 342.

This paper is a detailed study of many aspects (especially the route of infection) of the so-called Gradenigo syndrome, which consists of suppuration of the middle ear, pain in the temporoparietal region, and paralysis of the abducens nerve. The various pathologic bases that have been offered by other authors are circumscribed suppurative leptomeningitis, localized pachymeningitis, serous meningitis, inflammatory edema of the tip of the petrous pyramid, toxic neuritis, and reflex (labyrinthine) action.

The authors present fifteen case histories, three of the cases studied grossly and microscopically and reported in detail. Of twelve cases personally seen, ten recovered and two died.

A few interesting excerpts and conclusions follow: (1) There is no doubt that if signs of mastoiditis appear in the course of involvement of the middle ear complicated by paralysis of the abducens nerve, a thorough and complete mastoidectomy is the proper procedure. It is advisable to keep the wound open for a considerable length of time. But if the paralysis follows exenteration of the mastoid, as is frequently the case, what should be the line of treatment? Conservative measures are most frequently indicated. (2) Gradenigo reported four deaths in fifty-seven cases. (3) The infection may subside in the tympanum and mastoid cavity, but may progress toward the apex of the petrous pyramid with increasing severity. (4) Surgical approach to the apex of the petrous pyramid is indicated in the presence of progressive meningeal signs. (Sixteen references.)

Ralph W. Danielson.

Kestenbaum, Alfred. **Contribution to the clinical aspect of optokinetic nystagmus.** *Graefe's Arch.*, 1931, v. 124, p. 339.

After reviewing briefly the two principal theories for explaining the mechanism of optokinetic nystagmus, (1) that held by Barany and the majority

of other authors, (2) that maintained by Ohm, the author enumerates six different forms of conjugate directive movements of the eyes. These are: (1) optically produced movements of the eyes to focus upon an object forming at first an image upon a peripheral part of the visual field; (2) the focusing of the eyes as the result of an acoustic or tactile influence; (3) voluntary movement of the eyes in a definite direction rather than toward a definite object (in all these first three the directive motions of the eyes were jerky or spasmodic.); (4) slow, steady gliding movement to follow a moving object; (5) compensatory deviation or lagging of the eyes when the head is passively rotated during fixation of an object (the poorer the fixation, the less the possible deviation of the eyes and the more quickly simple deviation led to recurrence of an interrupted deviation, this to a repetition of the deviation, and the latter to a nystagmus); (6) the well-known compensatory deviation of the eyes in turning of the head dependent upon the labyrinth. (The last three forms were all slow, gliding fixation motions.) The most generally accepted theory for optokinetic nystagmus could therefore be stated by saying that optokinetic nystagmus was compounded of a slow, gliding, following or deviating phase (*Führungsbewegung*) and an abrupt optically developed focusing action (*Einstellbewegung*) upon a new object.

The most important causes for the failure of optokinetic nystagmus may be grouped thus:

- (1) Disturbance of the primary slow phase:
 - (a) through disturbance of the conjugate following motion of the eyes.
 - (b) through too little attention to the stripes upon the drum.
 - (c) amaurosis or high-grade amblyopia.
 - (d) because of fixation nystagmus.
- (2) Disturbance of the rapid phase:
 - (a) through disturbance of the

conjugate movement of the eyes to a direction.

- (b) through disturbance of the conjugate focusing of the eyes upon an object (hemianopsia).

Weakness of the ocular muscles might obstruct both phases. *H. D. Lamb.*

McCord, C. P. **Occupational nystagmus in train dispatchers.** *Jour. Amer. Med. Assoc.*, 1931, v. 96, April 4, p. 1131.

Among the 121 train dispatchers examined, in widely separated sections of the country, and from seventeen railroads, occupational nystagmus was detected in 81 individuals, or 67 percent. In addition, in two cities, among 30 persons examined, 22, or 70 percent, presented this condition. The nystagmus found was essentially all horizontal, with marked variation in the rate of motion, and with some variation in the rates for the two eyes. This train dispatchers' nystagmus appears to be unassociated with aural conditions, although occupational deafness of 56.2 percent has been noted, which is more commonly present in the left ear, on account of the wearing of the hearing mechanism on that ear. It is believed that the noises common to train dispatching are responsible for the occupational deafness. The nystagmus encountered among train dispatchers is accepted as occupational in origin and is attributed to the continual motion of the large paper train sheet beneath the eyes, and the movement of the head and eyes over the train sheet, both necessary in the continual recording of data concerning train movement.

It is maintained that the high tension of the use of eyes in connection with train sheet work leads to overworking of the ocular mechanism, resulting in a nervous syndrome characterized by nystagmus, blepharospasm, some visual impairment, and ocular discomfort.

This occupational nystagmus of train dispatchers is less severe than the average of miners' nystagmus, and no case has been encountered that in itself was to be accepted as the cause of total disability.

George H. Stine.

Marin Amat, M. **A case of Marcus Gunn syndrome.** Arch. de Oft. Hisp.-Amer., 1930, v. 30, Oct., p. 530.

The literature regarding the Marcus Gunn syndrome, of which a hundred cases have so far been reported, and in which there is an abnormal association between the levator and the motor portion of the trigeminus innervating the depressors and abductors of the lower jaw, is reviewed, and a case reported, making four reported by this author. While most of the cases are congenital and unilateral, and accompanied by ptosis, three bilateral, seven acquired cases, and eight without ptosis are among these reported. In most cases the association with lower jaw abduction is crossed. The lid defect is often accompanied by paralysis of other extraocular muscles. The physiologic prototype of the phenomenon may be found in the often observed involuntary simultaneous opening of the mouth when patients are commanded to open their eyes. In disagreement with the commonly held view that we are dealing with an abnormal central anastomosis, nuclear or supranuclear, the author argues for a peripheral anastomosis.

M. Davidson.

Minninger, W. C. **Postencephalitic oculomotor spasm, case report.** Jour. Kansas Med. Soc., 1930, v. 31, Dec., p. 442.

A man of twenty-five years had had an attack of encephalitis ten years previously. Six years ago he began having difficulty with his eyes, and he described them as whirling around, and unable to keep them focused in one place. This became progressively worse over a period of two years, forcing him to stop his work. Vision was good.

The eyes showed conjugate deviation upward and to the left, much fluttering of the eyelids, and simultaneous turning of the head to the left. The patient could momentarily bring the eyes downward to focus on a fixed object, but they promptly returned to the left upper quadrant and often remained fixed there for several minutes. As long as they were rolled upward he appeared

in a trance-like state, remaining motionless and speechless. The left pupil was slightly larger than the right, and both pupils were very sluggish to light. There was a fine nystagmus.

Stramonium produced remarkably effective somatic relief, as to tremor, sluggish cerebation, and the eye muscle spasms. The U. S. P. tincture was given orally in doses ranging from 20 to 70 minims three or four times a day. (References.) *Ralph W. Danielson.*

O'Connor, Roderic. **Ocular tendon transplantations.** Arch. of Ophth., 1931, v. 5, Feb., pp. 209-211.

The author has tried three methods of tendon transplantation and as examples records cases of paralysis of the external recti. In the first method, the inner two-thirds of the superior and inferior recti are transplanted under the remaining outer third and are attached at the corresponding margins of the external rectus. In a second method, the entire superior and inferior recti are transplanted. In the third method, the inner two-thirds of each muscle is transplanted to the external rectus over the remaining third of the superior and inferior recti. The author recommends the first method as better than any other, including transplantation of the external portion of the two muscles.

M. H. Post.

Perez Bufill. **Paralysis of ocular muscles after spinal anesthesia.** Arch. de Oft. Hisp.-Amer., 1930, v. 30, Sept., p. 484.

Three cases are reported: a double abducens paralysis, a one-sided trochlearis, and a one-sided abducens paralysis. All occurred about 14 days after the anesthesia, and were preceded by headaches, nausea or vomiting, which generally abated on the onset of the diplopia. Lues was excluded. The signs of meningeal irritation were most marked in the bilateral case. This argues for an inflammatory meningeal reaction to the anesthetic present in the cerebrospinal fluid as the cause.

M. Davidson.

Williams, T. A. **Mechanism of some convulsive movements of the orbicularis and of the face.** Arch. of Ophth., 1931, v. 5, Feb., pp. 273-275.

Certain convulsive movements of the orbicularis and of the face are the result of psychologic mechanisms, at times the result of some underlying physical origin. This latter may be a general toxic condition, or an endocrine disorder. Those cases due to a purely psychologic disorder are especially amenable to proper psychotherapy. These "convulsive and intemperate ties" are carried out with the consciousness of the patient and in response to an intense desire, and are followed by a definite sense of relief. The movement is often voluntary at first, later becoming involuntary. A typical example is that of winking the eye, starting from the irritation of a foreign body. A number of very interesting cases are reported.

M. H. Post.

5. CONJUNCTIVA

Addario, C. **The etiology of trachoma and the new diagnostic criteria from which therapeutics and prophylaxis are derived.** Ann. di Ottal., 1930, v. 58, Dec., p. 1074.

The author considers as conclusive the demonstration by Noguchi of *Bacterium granulosis* as the causative factor in trachoma. He reports a case in which he infected a human eye which was blind from other causes, but in which the conjunctiva was in normal condition, with a culture obtained from the original Noguchi experiments. This eye developed what he considers all of the pathognomonic symptoms of true trachoma. The observations were made day by day during the acute stage and later monthly for ten months. The pictures of the inverted lids which accompany the article and are exhibited by the author before the International Organization for the Control of Trachoma at Geneva, while having the general appearance of being trachomatous, were not sufficiently clear in the absence of the patient to be definitely accepted before that organization as being true trachoma.

It is indisputable that in trachoma there are two morbid entities which exist concurrently. The first is neoplastic in character and consists of the trachoma granules. The second is inflammatory and reactive and by reason of its varying intensity and duration causes different degrees of conjunctival hypertrophy, this explaining the seeming polymorphism of trachoma. The neoplastic structures (the gray granules) are always the same whatever may be the amount of inflammation, whether acute or chronic.

Park Lewis.

Bernard, Lucien. **On the rarity of trachoma in Tangiers. Contribution to its treatment by chaulmoogra oil.** Rev. Internat. du Trachôme, 1930, v. 7, Oct., p. 211.

Bernard comments on the extreme rarity of trachoma in Tangiers. Of 3305 school children examined, only twelve were found to be infected, and these figures coincide roughly with the evidence of trachoma in the adult population as judged by dispensary practice. No cause for this apparent immunity has been advanced.

The author describes his experiences in the use of chaulmoogra oil and concludes that while the drug is a valuable therapeutic remedy in trachoma it is definitely inferior to copper sulphate.

Phillips Thygeson.

Cucco, A. **The present condition of the problem of the etiopathogenesis of trachoma.** Ann. di Ottal., 1930, v. 58, Dec., p. 1039.

The author takes the researches of Noguchi and his collaborators of the Rockefeller Institute as a starting point, and he reviews the studies and the experiments of ophthalmologists throughout the world who have been seeking the causative agent in trachoma, his purpose being to adjudge the validity or at least the specificity of *Bacterium granulosis*. He concludes that with the exception of Addario there is a unanimity of results to the effect that the condition produced in monkeys was not true trachoma, and he bases his opinion on the fact that in none of the

conjunctivæ was there at any time the slightest evidence of scar tissue, and that some of these experimental cases made a spontaneous recovery, while in none of them was there any trace of the posttrachomatous conditions commonly found in clinical cases.

Park Lewis.

Harman, N. B. **Observations on the control of trachoma.** Canadian Med. Assoc. Jour., 1931, v. 24, p. 524. (See Amer. Jour. Ophth., 1931, v. 14, April, p. 310)

John, I. **The disturbances of sensibility of the cornea and conjunctiva in xerosis and keratomalacia of adults.** Arch. of Ophth., 1931, v. 5, March, pp. 374-391. (See Section 6, Cornea and sclera.)

Marin Amat, M. **Primary tuberculosis of the conjunctiva followed by nasal lupus.** Arch. de Oft. Hisp.-Amer., 1930, v. 30, Sept., p. 487.

Because of the rarity of primary tuberculosis of the conjunctiva a case is reported in detail. For three years, only a sensation of a foreign body and a gradual swelling of the lid was reported by the patient, to which was added a nasal catarrh and crust formation on the same side during the last year. Examination showed an excavated dirty ulcer on the conjunctiva, as well as typical manifestations of nasal lupus. Tuberculin and inoculation tests were positive, no bacilli were found in the scrapings, and the Wassermann was negative.

M. Davidson.

Morax, V. **The corpuscles of Provaczek-Halberstaedter and their frequency in trachoma.** Rev. Internat. du Trachôme, 1930, v. 7, Oct., p. 200.

Morax examined epithelial smears from twenty-eight cases of untreated florid trachoma in Algiers and demonstrated the presence of inclusions in seven, or 25 percent, of the cases. In two of the cases the inclusions were numerous, but they were rare in the other five.

Taborisky's 99 to 100 percent positive findings of inclusions in initial

trachoma are completely at variance with those of other authors, and Morax concludes that, in addition to typical intracellular inclusions, Taborisky has probably described other free or included elements. *Phillips Thygeson.*

Olitsky, P. K. **Relation of Bacterium granulosis to trachoma.** Rev. Internat. du Trachôme, 1930, v. 7, Oct., p. 173.

Olitsky reviews the experimental work which has been carried out on Bacterium granulosis since Noguchi's original report in 1928. Recent researches have confirmed Noguchi's findings and in addition have described important properties of B. granulosis, notably its sensitiveness to weak solutions of cocaine, its heat sensitivity, its viability for long periods of time on leptospira medium, and its profuse growth on ordinary laboratory media after repeated subculture.

Noguchi's studies in relation to experimental trachoma in monkeys have been confirmed and extended. The conveyance of the infection from monkey to monkey was described by Tyler and confirmed by Finnoff and Thygeson, and Olitsky and Tyler have infected normal macacus monkeys with material from both human and monkey lesions and have later recovered B. granulosis in both instances. Olitsky considers the spontaneous folliculosis of monkeys as definitely distinguishable from the disease induced by B. granulosis, alike by its clinical appearance, by absence of B. granulosis in the lesions, and by absence of cross immunity between the two diseases. Recent work appears to confirm Noguchi's conclusions that there is an intimate relationship of Bacterium granulosis to human trachoma. *Phillips Thygeson.*

Pascheff. **Chronic hyperplasias of the conjunctiva and true trachoma.** Rev. Internat. du Trachôme, 1930, v. 7, Oct., p. 189.

(See American Journal of Ophthalmology, 1931, v. 14, April, p. 375.)

Sjögren, H. **Carbon dioxide snow as a trachoma remedy.** Acta Ophth., 1930, v. 8, p. 29.

The author finds this treatment simple, effective, and harmless. He reports the results in forty-two patients. The method includes local anesthesia, eversion of the upper lid, and injection of novocain-adrenalin along the upper border of the upper lid tarsus, which balloons out and makes accessible the conjunctiva of the upper fornix. A stick of carbon dioxide is then held firmly against the conjunctiva for from fifteen to twenty seconds. The entire conjunctiva is treated, and the frozen lid is not permitted to touch the cornea until it has thawed out. The reaction is an edema of the lids, chemosis, and increased secretion. The after treatment is irrigation with oxycyanide of mercury until the reaction subsides, and then application of a copper ointment or stick. The treatment may be repeated several times, but never until the reaction from the previous treatment has subsided. The efficacy of the treatment depends on the pressure, the duration of the application, and the susceptibility of the tissue. Histologically the immediate effect consists in a vascular contraction and thrombosis. Twelve hours later there is a leucocytic infiltration, and finally the superficial cells become vacuolated, degenerated, and desquamated, the deeper epithelial cells remaining unaffected. Unless the application is too prolonged elastic tissue is not affected by the cold, therefore the treatment is not followed by extensive cicatrization.

Ray K. Daily.

Taborisky, J. Prowaczek-Halberstädter bodies and their clinical significance. *Graefe's Arch.*, 1930, v. 124, p. 455.

Observations during twenty years have justified the author in the position that there can be no trachoma without inclusions. He has never encountered a typical trachoma case, followed from the beginning, in which these bodies were absent. On the other hand he could never establish their presence in typical forms of conjunctivitis of a non-trachomatous character. Conjunctivitis with the presence of inclusions (with

the exception of inclusion blenorrhea) is exceptionally rare, and the inclusions always occur in the incipient stage of conjunctivitis with trachomalike changes (as papillary hypertrophy, diffuse infiltration, follicles) when not identical with acute trachoma. This proves that these bodies are not an accidental occurrence in these cases but are indeed the cause of these clinical peculiarities. Here there is present a nontoxic variety of the Prowaczek-Halberstädter bodies evidently of genital origin. These bodies appear in the beginning of trachoma, increase in number and size with the spread of the disease, persist more or less time in the epithelium in spite of treatment, to disappear temporarily or finally with the improvement of the disease.

The greatest resistance to the development of the inclusions is offered by the corneal epithelium, where these bodies remain only a few days in an incipient pannus or in the infiltrate. The next most resistant epithelium is that of the limbus, where the inclusions appear during the entire initial acute or subacute stage. Third in resistance is the conjunctiva of the sclera, where they persist from one or two weeks to eight or ten months. Least resistance is offered by the lid conjunctiva, where the inclusions can be found throughout the entire active stage of trachoma. They disappear during the inactivity of the disease and reappear again in its exacerbations. Chronic inclusion-blenorrhea is evidently a mixed infection of the gonococcus and other microbes with the Prowaczek-Halberstädter bodies, in which papillary hypertrophy with its depressions plays an important factor as a more favorable nutrient material.

H. D. Lamb.

6. CORNEA AND SCLERA

Gudjónsson, S. V. Xerophthalmia in rats and periocular reaction. *Acta Ophth.*, 1930, v. 8, p. 184.

The article is made up mainly of a series of photographs of rats, illustrating the course of xerophthalmia on a vitamin-A-free diet, and recovery on corrected diet. The periocular reaction,

which consists in loss of eyelashes with a red moist appearance of the lid border, occurs in xerophthalmia after introduction of vitamin A into the diet, and is indicative of the corrected diet.

Ray K. Daily.

John, I. The disturbances of sensibility of the cornea and conjunctiva in xerosis and keratomalacia of adults. Arch. of Ophth., 1931, v. 5, March, pp. 374-391.

For the purpose of this report, twenty patients with corneal and conjunctival disturbances due to lack of vitamin A were examined from time to time. Human hairs were used and tabulated for their "pressure value", as measured on a delicate balance. In the beginning of the disease, but after the appearance of Bitot's spots, the sensibility of cornea and conjunctiva was found unchanged. As the disease advanced to the stage of prexerosis and xerosis, the sensibility of the cornea might sink to one hundred times below the normal, and that of the conjunctiva to four times that found in the sound eye. The central part of the cornea suffers greater loss than the normally less sensitive peripheral portions. The lowered sensitivity remained for months after all other lesions had cleared away. The author believes that changes in the ciliary or Gasserian ganglia are responsible for the characteristic lesions of this disease, and that the nutritive or sympathetic center of these fibers is more easily affected by such lesions than the fibers of sensation, as proved by the more rapid appearance and disappearance of the former as compared with the latter. He further holds that hemeralopia, frequently present in the initial stages of vitamin-A deficiency, may be the result of centrally located disturbance or changes in the optic nerve.

M. H. Post.

Ladekarl, P. M. Two atypical cases of Groenouw's nodular keratitis. Acta Ophth., 1930, v. 8, p. 213.

The report is illustrated with drawings of the corneæ and of histologic sec-

tions of the excised corneal protuberances, and is followed by a very comprehensive review of the literature on the subject. The first case was in a woman twenty-six years of age who had bilateral central corneal opacities arranged in groups of varied configuration. The slit-lamp located these opacities subepithelially in Bowman's membrane and in the outermost layers of the substantia propria. The vision was 5/6, and corneal sensibility was normal. The patient's general condition was also normal. She stated that her mother suffered from a similar affection. The other patient, a woman thirty years of age, had no familial history, and had some symptoms of an obscure disturbance of the nervous system. Her corneal affection was of a somewhat inflammatory type. Corneal sensibility was normal. Vision was greatly impaired, but improved on excision of the nodular opacities. These excised nodules showed histologically a thinning of the epithelial layer and flattening of its cells, with vesiculation and vacuolation of the nuclei. Bowman's membrane was frayed or missing in the areas of thinned epithelium. In the superficial layers of the stroma two types of change were seen: a splitting of the lamellæ, and transformation to homogeneous masses, the latter being probably a hyaline transformation although this could not be demonstrated by the various methods of staining.

Ray K. Daily.

Mendoza, R. Surgery of the sclera. Arch. de Oft. Hisp.-Amer., 1930, v. 30, Sept., p. 476.

Surgery of the sclera has thrown light on pathogeny and treatment of two diseases diametrically opposed to each other, namely simple glaucoma and detachment of the retina. It is best to sharply separate the glaucomas into those with hypertension and those without it. Acute or subacute wet edematous glaucoma always has hypertension, while the simple noninflammatory dry glaucomas never have hypertension unless complicated. Simple glaucoma may eventually pass into in-

flammatory, but the mechanism in the two is fundamentally different. There is no increase of intraocular fluid in the former, while there is increase in the latter. This is demonstrated by the author's method of transillumination of the angle of the anterior chamber, which consists in oblique illumination in a dark room with a convex lens so that the pencil of rays is almost parallel to the surface of the cornea. The opposite angle lights up well in simple glaucoma, but there is only a thin luminous strip or no lighting up in the presence of hypertension. In simple glaucoma the diseased scleral capsule is contracting and there is a progressive diminution of the volume of the globe. The soundness of this conception and its practical importance is proved by the effectiveness of the author's procedure of scleral resection to prevent retinal detachment subsequent to scleral incisions for any purpose, which results from the giving way of the scar and consequent stretching of the scleral capsule. Simple sclerotomy or sclerectomy without suture and without iridectomy is the only justifiable procedure in uncomplicated simple glaucoma.

M. Davidson.

Nugent, O. B. **Ultraviolet radiation in the management of corneal ulcers.** Arch. Physical Therapy, X-ray, Radium, 1930, v. 11, Dec., p. 660.

After mentioning the usual forms of local treatment of corneal ulcer, Nugent says that ultraviolet radiation in his hands in the last two and one-half years has put practically all the foregoing local treatments in the discard. He argues that healing of corneal ulcers can be effected by this method without the necessity of curetment or cautery of the ulcer, which destroys a certain portion of healthy tissue around the ulcer.

Trachoma was also readily controlled and in a large percentage of cases cured by simple repeated application of the ultraviolet rays to the corneal surface.

The Birch-Hirschfeld radiation lamp of Zeiss was used in all the cases. One

case report of successful cure of trachoma is given. (Discussion.)

Ralph W. Danielson.

Pillat, Arnold. **Prexerosis and xerosis of the cornea as independent disease pictures of the eye in deficiency disturbances of adults.** Graefe's Arch., 1930, v. 124, p. 486.

Where there exists a deficiency of vitamin A there occur in adults in addition to true keratomalacia two other corneal conditions namely prexerosis and xerosis of the cornea. These latter conditions may persist for weeks or months without developing into keratomalacia, and usually retrogress rapidly under a rich vitamin-A diet. Both conditions are usually associated with night blindness or with one of the different forms of epithelial xerosis of the bulbar conjunctiva, but they may occur entirely alone. In China it is remarkable that in these deficiency diseases there frequently occurs a peculiar brownish pigmentation of the conjunctiva which, proceeding from the plica semilunaris and the vicinity of the caruncle, and in more seriously affected cases involving the conjunctiva of the fornix and the bulbar conjunctiva, may even extend into the cornea.

The prexerosis is characterized by diffuse dullness of the cornea. The sensitiveness of the cornea is as a consequence more or less greatly diminished. The same bacteria as in keratomalacia are found in the epithelial cells of scrapings from the cornea. Especially striking is the quick drying of the cornea when one holds open the eyelids with the fingers for several seconds.

The xerosis of the cornea is characterized by white or grayish-white deposits similar to Bitot's spots in xerosis of the bulbar conjunctiva; these deposits in the cornea may be confined to the limbus in the region of the palpebral fissure, or may be isolated in the corneal center, or may exist as a crescent-shaped xerosis at the limbus. The remainder of the cornea is affected by prexerosis.

Prexerosis and xerosis of the cornea are in a certain sense to be considered

as preliminary stages of the keratomalacia of adults, although the latter in general develops more frequently from prexerosis and more rarely from xerosis.

The prognosis of both prexerosis and xerosis is good; they heal without leaving any opacity in the cornea. Treatment consists in copious administrations of cod-liver oil and in a vitamin-rich diet. Local treatment is rarely indicated; when it is used it should be as nonirritating as possible.

H. D. Lamb.

Samoilov, A. J. **On the study of specific reactions in experimental tuberculous keratitis of rabbits.** Arch. Ophthalmologii (Russian), 1930, v. 7, pt. 6-7, pp. 721-739.

In order to establish the general character and the specificity of focal reactions in tuberculin tests, two series of experiments were carried out on rabbits affected with tuberculous keratitis. In one series hypodermic injections of old tuberculin were given. Following that, increased vascularization and some hemorrhages were noticed in the corneal infiltrates. On the other hand, no focal reaction was ever observed in a second series of experiments in which milk proteins were used for injections. The author concludes that the focal reactions in tuberculin tests are definitely specific. Tonometric examinations performed in these experiments showed decrease of intraocular pressure following tuberculin injections. This is considered by the author as a manifestation of focal uveal reaction.

M. Beigelman.

Sédan, Jean. **Phlyctenular keratitis in the trachomatous.** Rev. Internat. du Trachôme, 1930, v. 7, Oct., p. 203.

Sédan describes the evolution of phlyctenular keratitis complicating the various stages of trachoma, florid, cicatrizing, and completely cicatrized. The phlyctenular-trachomatous association is frequent especially in the winter, and the practitioner is warned to examine carefully the tarsal and supratarsal con-

junctiva for trachomatous lesions before concluding that the phlyctenular disease is benign. Sédan makes the following observations:

(1) Phlyctenules of the center of the cornea are very rare in perfectly cicatrized trachoma. (2) Phlyctenules of the upper half of the limbus are rare. (The vascularization incident to pannus may have a protective effect for the upper limbus.) (3) The duration of the phlyctenular disease is extremely prolonged in cicatricial trachoma. (4) Even completely cicatrized trachoma aggravates phlyctenular keratitis. The latter rarely causes the trachoma to flare up. (5) A tendency to recurrence is usual in phlyctenulosis complicated by cicatricial trachoma. (6) There is frequently present important nasal pathology in these patients. (7) Mercury ointments, used for treatment of the phlyctenulosis, have an unfavorable action on cicatrized trachoma.

In florid trachoma, the presence of phlyctenulosis exaggerates the disease to a maximum, producing a purulent secretion, sometimes very abundant, but the trachoma has an effect much more marked and aggravating on the phlyctenular disease than the latter has on it, for under its influence the phlyctenules have a deplorable tendency to widespread invasion of the cornea, which too often results in scarring. Sédan concludes that in the majority of cases therapy should be directed primarily to the trachoma, as the phlyctenular disease will improve coincidentally with the underlying disease.

Phillips Thygeson.

Sjögren, H. **A case of drug idiosyncrasy with unusual corneal changes.** Acta Ophth., 1930, v. 8, p. 290.

The author reports the case of a woman seventy-five years of age who, immediately upon ingestion of a powder composed of caffeine, phenacetin, and antipyrin, suffered an attack of urticaria, edema of the lids, and impaired vision. The next day her lids were still edematous, the conjunctivæ congested, and the corneæ dull. Under the microscope were seen small superficial cor-

neal erosions, subepithelial infiltration, and loosened epithelium still adherent to large central erosions. Corneal sensitivity was normal. The following day the patient had a bilateral striate keratitis, which subsided in two weeks. The author considers this a case of allergy, with the cornea as the "shock organ". He believes the change to be due to an increased permeability of the corneal endothelium, which permitted the entrance of aqueous humor into the corneal parenchyma. *Ray K. Daily.*

7. UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Friedenwald, J. S., and Rones, B. **Ocular lesions in septicemia.** *Arch. of Ophth.*, 1931, v. 5, Feb., pp. 175-188.

Thirty-two cases of septicemia were studied clinically and later pathologically after autopsy. The posterior segments of the eyeballs only were obtained, as a rule. Septic retinitis was not considered, though it occurred occasionally. In nine cases, foci of infiltration occurred in the choroid. They were always bilateral and consisted in loose accumulations of mononuclear wandering cells lying in the stroma. Small lymphocytes predominated. Large lymphocytes and large mononuclear cells resembling the transitional cells of the blood stream were also seen in considerable numbers. Plasma cells and epithelioid cells were more rare. Local tissue necrosis and hemorrhage were absent. The overlying retina escaped. These findings support the conclusions of Szily, rather than those of Marchesani, the latter of whom felt that an "allergic choroiditis" similar in nature to sympathetic ophthalmia was produced in the fellow eye by inoculation of the vitreous of the other.

Endocarditis lenta is supposedly the result of streptococcus viridans. Gilbert attempted to correlate this disease with chronic septic uveitis, which he called ophthalmia lenta. Herrenschwand agreed with him in defining the ocular lesions as bilateral iridocyclitis with hypopyon. Some investigators found the most severe changes in the anterior

vitreous, resulting in scar tissue masses. In the choroid, perivascular and nodular lymphocytic infiltrations were also found. But Weve denied its relation to endocarditis lenta. The most characteristic ocular lesion of this disease is so-called septic retinitis, accompanied by petechial hemorrhages with yellowish or white centers.

In the cases here reported the earliest lesions were polymorphonuclear infiltrations, occurring about occluded vessels, mononuclears later appearing, but no plasma cells. These lesions appeared to be embolic resulting from bacterial endocarditis. In the second case there was a typical picture of albuminuric retinitis, with extreme sclerotic changes in the retinal arteries. There were three rounded, yellowish elevations in the macular region, behind the retina. The albumin in the urine was four plus. These elevated areas in the macula were found definitely related to sclerotic and partially thrombosed arteries. There was an organized inflammatory mass made up of fibroblasts and large mononuclear wandering cells. Streptococcus viridans septicemia was the terminal condition. The authors rule out syphilis, arteriosclerosis, and chronic nephritis as the causation of these nodules, attributing them to a terminal septicemia. They report cases by other authors substantiating these conclusions. A case of periarteritis nodosa is reported, complicated by albuminuric retinitis. No similar case has ever been subjected to histological examination. No evidence of inflammatory lesions in the retinal arteries could be found. There was, however, extreme arteriosclerosis. In all, nine cases out of the thirty-two showed ocular lesions, some of which had never been previously reported from an anatomical and pathological standpoint. *M. H. Post.*

Gill, W. D. **Uveal pigment in the diagnosis and treatment of sympathetic ophthalmia.** *Southern Med. Jour.*, 1930, v. 23, Oct., p. 885.

Gill gives a résumé of the literature on the anaphylactic theory of the etiology of sympathetic ophthalmia. He de-

scribes the methods used in preparing the antigen, testing the patient, and treating the disease. Seven case reports and discussion are included, and the following conclusions are stated:

(1) Sympathetic ophthalmia or sympathetic uveitis has an allergic phase, and uveal pigment appears to be the anaphylactogen responsible for sensitization. (2) Intradermal injection of uveal pigment suspensions will reveal hypersensitiveness to uveal pigment. (3) Clinical improvement, at times spectacular, follows the employment of uveal pigment therapy in sympathetic ophthalmia, provided it is used early in the disease. (4) Focal infections frequently appear to bear a definite relationship to the production of sympathetic ophthalmia. (5) Other forms of treatment may be combined with uveal pigment therapy to good advantage. (6) Enucleation is often avoided by using uveal pigment therapy early in sympathetic ophthalmia.

Ralph W. Danielson.

Sommer, Ignaz. **Herpes zoster ophthalmicus in its relation to sympathetic ophthalmia and inner ear lesion.** Texas State Jour. of Med., 1930, v. 26, Oct., p. 421.

In two cases sympathetic ophthalmia followed herpes zoster ophthalmicus which involved the cornea. In another case unilateral deafness developed during the course of a herpes zoster ophthalmicus. Sommer mentions that the similarity of appearances, clinically and histologically, in sympathetic ophthalmia, herpes zoster ophthalmicus, and experimental herpetic infection of the rabbit's eye raises the question of the identity of these diseases. (Bibliography and discussion.)

Ralph W. Danielson.

8. GLAUCOMA AND OCULAR TENSION

Castroviejo, Ramon. **The pathology of chronic simple glaucoma.** Arch. of Ophth., 1931, v. 5, Feb., pp. 189-208.

This is a general review of the subject, without new facts or theories. Factors emphasized include generalized

angiosclerosis, hypermetropia, and changes in osmotic equilibrium.

M. H. Post.

Costi, C. **Glaucoma with premenstrual exacerbations.** Arch. de Oft. Hisp.-Amer., 1930, v. 30, Oct., p. 521.

In a case of chronic inflammatory glaucoma of one year's duration in a woman of forty-two years acute attacks occurred regularly two to five days before menstruation, with remissions in the intervals. The premenstrual attacks were only controlled by increasing the instillations of pilocarpin to four times daily, instead of twice, beginning five days before and continuing through menstruation. The attacks were accompanied by slight increase in blood pressure and a positive Goetch reaction to adrenalin injection. From a study of the literature regarding the rôle of the sympathetic and that of arterial hypertension in the pathogenesis of glaucoma, and from the fact that menstruation is accompanied by a state of sympathicotonia as well as arterial hypertension, the author concludes that the last two are important factors in the production of ocular hypertension.

M. Davidson.

Feigenbaum, Aryeh. **Reflex transmission of stimuli from one eye to the other: the "dark-light test" following neurectomy.** Arch. of Ophth., 1931, v. 5, Feb., pp. 261-268.

This test was first described by Grönholm in 1910, and studied by Seidel in 1920. It has been found that in glaucoma an increase of tension occurs following a stay in the dark, and a decrease following exposure to light. A similar effect is found in normal eyes, though less marked. After illumination of one eye, there is a reduction in intraocular pressure in the fellow eye, parallel with that observed in the first experiment. According to former observers, this change in tension is due to the dilatation and contraction of the pupil, the result of the effect of light upon the eye. The author, however, rejects this explanation, as it does not stand the test of fixation of the pupils by drugs

in aniridia after iridectomy, and so on, nor in cases of illumination of a blind eye with consequent lowering of pressure in the second eye. There are, however, exceptions to this latter finding, as in the case of hypotonicity in a glaucoma of long standing.

The author performed an opticociliary neurectomy on three patients with chronic inflammatory glaucoma. Before operation all of them showed typical fluctuations in the better eye on illumination of the nearly blind eye, but no such change following operation. In two other cases the results were negative, but in the first of these the reaction was not obtained before operation, and the second case was one of unilateral glaucoma following thrombosis of the central retinal vein. The author therefore concludes that the neurectomized eye reacts in a typical way, and he assumes for this a sharp reflex that does not pass through the center, such as an intraocular vasomotor reflex of the uveal vessels, and that the influence of the second eye also consists in a primitive reflex of this type. In absolute glaucoma with hypotonia, where degeneration of the nervous receptor organs has taken place, no response occurs. It therefore appears that this parallelism is due to a vasomotor reflex, and that a secondary glaucoma would not show this reflex, as it does not arise from vascular but from mechanical causes. In dark adaptation, the eyes act as though there were no irritation of the cervical sympathetic, whereas in light adaptation the effect is that of stimulation of the parasympathetic. It appears that there is rather a far-reaching coordination between light and dark adaptation than a direct effect due to the size of the pupil in dark and light adaptation.

M. H. Post.

Ferree, C. E., Rand, G., and Sloan, L. L. **Sensitive methods for the detection of Bjerrum and other scotomas.** *Arch. of Ophth.*, 1931, v. 5, Feb., pp. 224-260.

In order to study faint or incipient scotomas it is necessary to reduce the

sensitivity associated with the stimulus. The three principal factors entering into the sensitivity are size of the object, difference in coefficient of reflection between the object and the background, and intensity of illumination. The visibility of an object increases rapidly with increase in the intensity of illumination, and vice versa. Therefore, the sensitivity associated with the stimulus may be decreased by decreasing any two or all three of these factors. It has been found that colored stimuli yield vastly greater sensitivity than white or gray stimuli, which can be explained by the fact of the low visibility of the colored stimuli in the paracentral and peripheral portions of the retina, and a special susceptibility to the various colors in different pathological conditions. Only with difficulty can form stimuli be reduced in the paracentral and peripheral portions of the retina to as low visibility as colored stimuli, and the same methods of obtaining this reduction in form stimuli are much less effective than in colored stimuli.

The effective use of colored stimuli requires backgrounds of gray, of a brightness similar to that of the color; otherwise the test object, when it loses its color, fades to a gray which continues to act as a form stimulus. Backgrounds differing in brightness from the stimulus give somewhat erratic results. Test objects of low visibility often give the first indication of disturbances in the eye, and the delicate changes which they record are of value in study of the progress of the disease and the ability to prognosticate its outcome. By their use the authors have abundantly demonstrated that the Bjerrum scotoma frequently arises as distinct and detached from the blind spot, only later merging with it. The extension of the blind spot in glaucoma may begin either above or below, and may first merge with the contracting field border either above or below. These test objects of extremely low visibility have little value in determining the magnitude of the field. Their special value lies in study of the blind spot, of cuts and irregularities in shape of the

field, of scotomata, and of the advance and recession of pathological conditions. Fifteen cases are reported in considerable detail in this very interesting paper.

M. H. Post.

M. J. Fradkin, M. L. Krasnov, M. J. Heifetz. **The alkaline reserve of blood, and the intraocular pressure.** Arch. Oftalmologii (Russian), 1930, v. 7, pt. 6-7, pp. 786-793.

Meesmann's assertion of glaucoma as accompanied by alkalosis of the blood was verified by the authors on two groups of patients. Examination of the alkaline reserve of the blood in a group of thirty-eight glaucoma patients brought out, contrary to Meesmann's theory, a tendency to acidosis. In another group of individuals who had an increased alkaline reserve (forty-nine patients affected with cancer and nineteen epileptics) no increase of intraocular pressure was found. Experiments on rabbits proved that changes in the alkaline reserve of the blood had no effect on intraocular pressure.

M. Beigelman.

Gjessing, G. A. H. **A strange complication in an ordinary enucleation.** Acta Ophth., 1930, v. 8, p. 206.

As the optic nerve was being severed during enucleation, under local anesthesia, of a painful blind glaucomatous eye, the other eye, which had had an iridencleisis several years ago, and was in fairly good condition, suddenly became amaurotic. It remained completely amaurotic for three minutes; after five minutes it had recovered light perception; and after from seven to eight minutes the patient counted fingers at two meters. Six days after the operation he had only one-half of the preoperative central vision, and the field was narrowed. The tension was unchanged. Four weeks after the operation central vision was regained, but the field remained contracted. The author attributes this complication to the ten drops of adrenalin used in the local anesthesia. He believes that too strong a concentration of adrenalin in the blood may have produced complete

ischemia of the optic nerve, in an eye previously weakened by disease.

Ray K. Daily.

Grosz, Emil. **The operative treatment of glaucoma.** Arch. of Ophth., 1931, v. 5, March, pp. 327-333.

In the Budapest University Eye Clinic the following principles are set down for consideration in the choice of operation: (1) inflammatory glaucoma prodromal and acute stage, iridectomy (Graefe); (2) chronic inflammatory glaucoma, cyclodialysis (Heine) or trephining (Elliot); (3) glaucoma simplex, iridosclerectomy (Lagrange); (4) juvenile glaucoma, anterior sclerectomy (de Wecker); (5) glaucoma degenerative stage, enucleation (Arlt).

The author notes that glaucoma is still the most frequent cause of blindness and that the most effective weapons for its conquest are the education of communities, postgraduate medical instruction, the decentralization of ophthalmologists, and the establishment of hospitals or wards in the country.

M. H. Post.

Ishikawa, Fukumi. **Experimental glaucoma in dogs with particular reference to changes in the optic nerve.** Graefe's Arch., 1930, v. 124, p. 387.

In about one-half the number of dogs used the author succeeded in producing an experimental glaucoma through injection into the anterior chamber of an emulsion of paraffin or of a suspension of pigment. A sudden increase of tension usually occurred about twenty-four hours after the injection, accompanied by moderately intense signs of irritation in the anterior half of the eyeball, so that the clinical picture in this stage coincided essentially with human acute glaucoma. In addition the eyeball showed a rapidly increasing hydrophthalmic enlargement which usually reached its height within a week. Small cavities of Schnabel were regularly found in the optic nerve, most pronounced in the intralaminar part and somewhat less common in the retrolaminar region; in one case these cavities were observed when an increase of

tension had been present for only two days. Glaucomatous excavation of the papilla which was observed in six out of twelve dogs having experimental glaucoma did not occur as a result of cavernous atrophy of the head of the optic nerve but always as the result of the backward displacement of the lamina cribrosa. The displacement of the retina into the glaucomatous cup, frequently observed by the author in his experiments as well as in human glaucoma, was caused by the pull of the lamina cribrosa as the latter was pushed backward by the increase of tension.

H. D. Lamb.

Ridley, Frederick. **The intraocular pressure and drainage of the aqueous humor.** *Brit. Jour. Ophth.*, 1931, v. 15, Feb., p. 102.

This is a refutation of the criticism by Duke-Elder, contained in the *British Journal of Ophthalmology*, December, 1930, of an investigation on the above subject published by the present author in the *British Journal of Experimental Pathology*.

The author's thesis brings forward experimental evidence that the normal living cornea is permeable to diffusible substances and that the osmotic pressure due to the lacrimal protein and the hydrostatic force exerted by the intraocular pressure determine the constant passage of fluid through the cornea. He claims to prove that there is a constant drainage of fluid out of the anterior chamber through the cornea in the normal living eye. In order fully to appreciate this discussion the original contributions should be consulted.

D. F. Harbridge.

Rosengren, Bengt. **A study of the depth of the anterior chamber with special reference to primary glaucoma.** *Acta Ophth.*, 1930, v. 8, p. 99-136.

The author reviews and evaluates the accuracy of the various methods and instruments devised for measuring the depth of the anterior chamber. The distance measured is the distance from the anterior corneal surface to the anterior surface of the lens, because measurement of the distance from the pos-

terior corneal surface to the anterior surface of the lens is technically very difficult. Of the available apparatus that devised by Lindstedt is capable of the greatest accuracy, because it has only one possible source of error. The author gives a tabulated report of the age, the vision, the refraction, the corneal radius in the vertical meridian, and the depth of the anterior chambers of 310 individuals.

Ray K. Daily.

Sondermann, R. **Contribution to the development and morphology of Schlemm's canal.** *Graefe's Arch.*, 1930, v. 124, p. 521.

Schlemm's canal is not originally developed as a circular channel, but it arises from vessels running radially which in the second month and the first half of the third month conduct blood from the tissue in front of the external limit of the optic cup to the anterior ciliary veins. These vessels course radially through a broad stretch in the marginal lamellæ of the sclera at the point of entrance into the scleral tissue proper; a circumscribed dilatation results from the blocking influence from the thickened sclera; for the remainder of its course the vessel becomes obliterated. These dilated places in the different vessels become connected together by means of dilated capillaries, producing a circular channel which later becomes Schlemm's canal. Because of this multiform origin there may be found in the same eye, as a part of Schlemm's canal, a large lumen alternating with several small lumina arranged in a plexus. The filtration spaces in the ligamentum pectinatum are in open connection with Schlemm's canal by means of a small inner canal which usually opens into Schlemm's canal near its lateral end. In contrast, small outer canals running to the anterior scleral veins always branch off from the medial half of Schlemm's canal.

H. D. Lamb.

Weekers, L. **The mechanism of hypotony in surgical and medical glaucoma therapy.** *Acta Ophth.*, 1930, v. 8, p. 253.

As opposed to Hamburger, who believes that glaucoma therapy acts by

setting up an inflammatory process, the author maintains that the essential factor in the mechanism of lowering tension is a change in the uveal circulation. A uveal vasodilatation, either primary or secondary to vasoconstriction, acts in two ways. First, it augments the exchange of ocular fluids: more fluid enters the eyeball and more leaves. Second, it alters the relation between the production and elimination of aqueous humor. In comparison with the normal the rate of elimination is greater than the rate of production, which accounts for the lowered tension. On this hypothesis the action of the various drugs and surgical procedures used in glaucoma is explained. The author performed iridectomies on rabbits, and one year later, on introducing fluorescein into the general circulation, he found that its appearance in the aqueous humor of the operated eye was greatly retarded. He concludes that the iridectomy produced in the circulation of the anterior uveal segment an alteration which inhibited the flow of fluids from the blood toward the ocular tissues. In glaucomatous eyes about to be enucleated the author succeeded in reducing the tension for a long time, and sometimes permanently, by several cyclotomies—wounding the ciliary body with a cataract knife. The most surprising phenomenon in these experiments was the remarkable manner in which the eye tolerated this traumatism.

Ray K. Daily.

Wright, and Nayar, K. K. **Trephining in the treatment of congenital glaucoma.** *Brit. Jour. Ophth.*, 1931, v. 15, March, p. 166.

This reports a rather unusual group of four brothers with congenital glaucoma, suggesting familial sex-linked characters.

(1) Male aged twenty-six years, R. V. 6/36, L. V. 6/24. Corneæ 13 by 14 mm., clear, tension 80 mm. (McLean). The right eye was trephined: vision five years later was 6/6, field restricted. The left eye was treated with miotics but was lost.

(2) Male aged twenty-four years, blind. Corneæ 14 mm., tension 45 mm. Hg. Both eyes showed staphylomatous

changes. The case was hopeless when observed.

(3) Male aged nineteen years, vision each eye 6/5. Corneæ 12:5 mm., tension 17 mm. (Bailliant), fields normal. He was apparently normal and remained so.

(4) Male aged fifteen years, vision each eye 6/5. Corneæ 14 mm., deep nerve cupping. The right eye, which was trephined, was in better condition four years later than the left, which was trephined at that time.

The success or failure of an anterior decompression must very largely depend on whether the normal relationship of aqueous and vitreous is preserved.

D. F. Harbridge.

9. CRYSTALLINE LENS

Fischer, Franz. **The budding off of the lens from the ectoderm in man.** *Graefe's Arch.*, 1930, v. 124, p. 507.

Eleven human embryos having a greatest length of from 6.5 to 9 mm. were studied by the author. In embryos of 6 and 6.5 mm. greatest length there was present a lens furrow, whereas in all embryos from 10 to 12 mm. long the lens vesicle had already separated from the ectoderm. The budding off of the lens therefore occurs in embryos from 7 to 9 mm. long. Among nine embryos of this length, three were in the stage of the lens sac and six in the stage of the lens vesicle which still remained in connection with the ectoderm.

It was found that the budding off of the lens from the ectoderm might occur in one of two ways. In one form the opening of the lens sac to the surface gradually narrowed as the fold joining the ectoderm to the outer lens wall became wider. It appeared as though the dorsal and ventral parts of this fold grew toward one another until their free margins touched and they grew together. In the midst of this junction there occurred a separation between the ectoderm and the distal wall of the lens vesicle. In the other type, instead of the folds growing toward one another until they touched, only the outer ectodermal layer closed its part of the opening, so that the ectoderm grew over the lens.

H. D. Lamb.

NEWS ITEMS

News items in this issue were received from Drs. F. L. Beck, Cheyenne; M. Brown, Philadelphia; C. A. Clapp, Baltimore; and G. Oram Ring, Philadelphia. News items should reach **Dr. Melville Black** by the ninth of the month.

Deaths

Dr. Wesley Lyman Curtis, Lincoln, Nebraska, aged sixty-one years, died March ninth of cerebral hemorrhage.

Dr. Edward William Wright, Saint Petersburg, Florida, aged seventy years, died March ninth of carcinoma of the liver.

Miscellaneous

A free trachoma clinic which will last through July is being conducted at Bainbridge, Georgia. It is being sponsored by the United States Public Health Service, the Georgia State Board of Health, and Decatur and Mitchell counties.

The Indiana University School of Medicine, Indianapolis, will offer to medical practitioners in the state a six-weeks' graduate course beginning June sixteenth. Ophthalmology will be included with the other departments of medicine.

The Children's Fund of Michigan is sponsoring in Mecosta County a series of clinics to treat children with defective vision. When the clinic leaves Big Rapids it will visit Remus, Morley, and Barryton. Dr. Sarah K. D. Schweinsberg, formerly of Philadelphia, is directing the work. It is reported that the Fund will furnish glasses free to children of indigent parents.

The National Society for the Prevention of Blindness will issue a journal entitled the "Sight-saving Review", a quarterly intended to serve both popular and technical groups, including social workers, ophthalmologists, illuminating engineers, educators, and others interested in the sociological phase of sight saving. The editorial board includes Drs. E. V. L. Brown, Chicago; William H. Wilmer, Baltimore; Edward Jackson, Denver; and Thomas D. Wood, New York. Lewis H. Carris, managing director of the society, is the editor.

The Middlemore Prize will be awarded for the best essay or work on any subject in ophthalmology which the council of the British Medical Association may select. The council is prepared to consider an award of the prize in 1932 for the best essay on "Sympathetic ophthalmia before and after 1914". Essays must reach the medical secretary, British Medical Association House, Tavistock Square, London, W.C. 1, not later than December thirty-first. Each essay must be signed with a motto, accompanied by a sealed envelope marked on the outside with the motto and containing the name and address of the author. If no essay is of sufficient merit, the prize will not be awarded in 1932.

Dr. Y. Ito, professor of ophthalmology in the Chiba Imperial Medical College, Tokyo, attended the meeting of the organization committee of the International Antitrachoma League as a delegate from Japan. After considering Dr. Ito's report Japan agreed to cooperate in future with the International Antitrachoma League. Under the auspices of the

departments of the interior, foreign affairs, and plantation, a graduate course on trachoma was given by Dr. Ishiwara, professor of ophthalmology in the Tokyo Imperial University, to general practitioners and local health officers in those prefectures from which laborers are being sent to the plantations of South America and elsewhere.

The management of the *Revista Cubana de Oftalmologia y Oto-Rino-Laringologia* offers volume four of that journal (January to June, 1931) free of charge to ophthalmologists in the United States who are able to read Spanish. Communications should be addressed to Dr. Tomas R. Yanes, Wilmer Ophthalmological Institute, Baltimore.

The retiring editor of the *American Journal of Ophthalmology* (Dr. Crisp) has a limited number of reprints of the Lindner and Barkan reminiscences of Ernst Fuchs which were included in the April issue; and will be glad to send single reprints to those especially interested, within the numerical limit available.

Societies

At its April meeting the Section on Ophthalmology of the College of Physicians of Philadelphia was favored with a paper by Dr. Joseph Earl Moore of Baltimore upon "Syphilitic optic atrophy". The discussion was opened by Dr. John Stokes, professor of dermatology at the University of Pennsylvania. Two additional papers were presented; one by Dr. T. B. Holloway and the other by Dr. Alfred Cowan, upon "Spontaneous, complete absorption of a cataractous lens". Dr. Hunter Scarlett gave a paper on "Senile macular changes of the retina associated with focal infection".

Fellows of the American Academy of Ophthalmology and Otolaryngology are reminded that the next annual meeting of the Academy will be at French Lick, Indiana, September 14 to 19, 1931. Communications with regard to the program should be addressed to the executive secretary, Dr. W. P. Wherry, Medical Arts building, Omaha, Nebraska.

Personals

Word has been received of recent improvement in the condition of Dr. L. Webster Fox, who had been very ill.

Dr. Harvey J. Howard, professor of ophthalmology, Washington University, Saint Louis, has received a flight surgeon's diploma from the School of Aviation Medicine, Brooks Field, Texas.

Dr. John McLeod, formerly of Kansas City, has moved to Marshalltown, Iowa, where he will be associated with Drs. Otis Wolfe and F. L. Wahrer.

Dr. S. Judd Beach announces the association with him in practice of Dr. W. R. McAdams, recently ophthalmic house officer at the Manhattan Eye, Ear, and Throat hospital.